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THE TELEGRAPHIC JOURNAL AND
Electrical Review.
VOL. XVII.—NO. 420.

THE ELECTRIC LIGHTING INSTALLATION AT PADDINGTON.

IF all we hear and read be true, a curious state of things has been allowed to prevail at Paddington Station. Nearly two years ago the directors of the Telegraph Construction and Maintenance Company, who have Sir Daniel Gooch at their head, persuaded the board of the Great Western Railway Company, which also is presided over by Sir Daniel Gooch, to admit of their lighting by electricity the London terminus of the Great Western line. Whether it was on both sides clearly understood, when the work was commenced, that the installation was to be merely of an experimental character we cannot say, but about nine months ago we find the Chairman of the Telegraph Construction Company informing his shareholders that the Paddington lighting was not expected to pay except in the sense that it would teach them "exactly what the cost would be"—presumably having in his mind the possibility of acting upon the Provisional Order for electric lighting in the St. James's district which the company obtained from Parliament. So that here has been proceeding for more than a year a gigantic experiment the object of which is to determine the amount of money an electric lighting installation on a large scale will cost, the fact being clear that it cannot pay its way, and must result in a dead loss to the shareholders.

The whole matter of the Paddington installation has, from the beginning, been involved, as far as all but a few favoured individuals have been concerned, in mystery; indeed, beyond the brief utterances, meagre in regard to facts, elicited from Sir Daniel Gooch by enquiring shareholders, nothing has been made public, and real information as to the progress made has been difficult to obtain. Latterly, however, the residents in the neighbourhood of the station have given vent in the Press to their indignation at the discomfort they have perforce to endure, by reason of the noise, vibration, and filthy fumes caused and emitted by the colossal machinery employed in generating the electric current. From the statements made by several writers in the columns of the *Times*, and by the parties who moved for an injunction in the Marlborough Street Police Court, it would seem to be far from a pleasant experience to reside in the vicinity of the Paddington Railway Station, and it is possible that the ambitious experimenters may shortly find themselves subjected to an abrupt check in their proceedings. Our own opinion as to the ultimate fate of the Paddington electric lighting was formed at the time the project was first mooted; but it may be premature now to publicly state our conviction. There is no reason, however, why we should refrain from making any endeavour to procure definite information regarding a matter so important, and, therefore, we would ask if there is any truth in the rumour that a number of the gutta percha covered wires have been discovered firmly run together into a compact mass at the bottom of the pipes in which they were laid? Lest the directors of the Construction Company should be ignorant of the fact that the matter is so much criticised by experts, we may state that it is said that the laying down of the cables generally has not been carried out in a manner altogether satisfactory. It is certainly time that a full investigation of the history of the gigantic scheme should be made in the interests of the shareholders and of the public, and, if such a course has not already been adopted, we would suggest that it would be good policy on the part of the shareholders of the company to institute a commission of inquiry.

It is to be feared, when schemes hang fire to such an extent, that either the entire plant has not given the results expected, or that the expenses needful to the successful carrying out of such undertakings are difficult to meet. In any case, the delay is irksome to the public, and detrimental to the progress of electric lighting.

SOME ELECTRIC LIGHT TESTS.*

(Continued from page 473.)

THE resistance of the armature of the dynamo was measured and found to be ·057 ohms. The resistance of the helices was found to be 35·2 ohms. The current was regulated by throwing additional resistance into circuit with the helices as lights were turned off on the line. The total electromotive force was found thus: The resistance external to the armature was computed by Ohm's law, viz., $R = E/C$. Let E_1 represent the total electromotive force, and E, the observed; then $C = E/R = E_1/(R + {\cdot}057) \therefore E_1 = \left(\frac{R + 0{\cdot}57}{R}\right) E$. The current in the helices of the electromagnet is found in the following manner. Let R_1 equal the resistance and C_1 the current of the circuit containing the helices; let R and C be the combined resistance and current of this and the line circuit. Then $C_1 R_1 = C R$; or $C_1 = \frac{R}{R_1} C$.

By electrical efficiency is meant the efficiency of the dynamo in converting mechanical into electrical work. It includes the friction of the armature bearings and of the belt transmitting the power from the driving pulley of the engine. By commercial efficiency is meant the ratio of the available electrical work to the mechanical work given off by the driving pulley of the engine. It includes both the energy expended in the lamps and that wasted in heating the conductors external to the dynamo.

MEAN RESULTS.

Pounds of coal per net electrical horse-power per hour	17·63
Pounds of coal per one lamp per hour	1·486
Number of lamps per net electrical horse-power	11·86
Number of lamps per indicated horse-power ...	8·17

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* Abstract of a thesis in the department of Mechanical Engineering, University of Michigan, read also before Section D of the American Association for the Advancement of Science, August 28 1885, by Frank C. Wagner.

B

THE VAN DEPOELE ELECTRIC LIGHT PLANT.

In this plant two dynamos were used, the smaller one generating the current for the field magnets of the larger. Thirty-three arc-lights were included in the circuit of the larger dynamo. These were kept running steadily through most of the evening, a few being turned off toward the close. The line was formed by about 1·3 miles of No. 7 B. W. G. copper wire. The dynamos were belted directly to the two driving pulleys of a Ball engine.

Two electrical tests were made of these dynamos, one on June 2, the other on June 18. The manner of making the test was as follows: The entire main current was sent through the dynamometer, which was reversed or switched out of circuit at will. The current of the exciting dynamo was measured by the ampèremeter. To find the mean resistance of a lamp, the electromotive force of two lamps was measured by the apparatus used in the Edison test, at the same time that current measurements were made. By Ohm's law we have the resistance, $R, = E/C$. On the evening of June 18, all these measurements were made, together with the taking of boiler pressures, revolutions and indicator cards, every fifteen minutes. On June 2 only the main current was measured. In the calculation the resistance of the lamps and the energy of the exciting circuit are assumed to be as found on June 18. The energy of the exciting circuit was calculated by the formula $W = C^2 R$. For the main circuit, the mean resistance of one lamp, found to be 3·055 ohms, was multiplied by the number of lamps (33 on June 2, and 32 on June 18); and to this was added the resistance of the armature and line wire. Several attempts were made to measure the resistance of the line directly; but it was found that the line circuit included a resistance which varied with the electromotive force used. The resistance was therefore calculated from the length and diameter of the wire. It is well to note that if the resistance were greater than it was assumed to be (it cannot be less), both the electrical and commercial efficiencies would be increased. The efficiencies were calculated in the same way as in the Edison test. The following are the averages for the test of June 2.

Duration of test	3½	hrs.
Steam pressure	68	lbs.
Revolutions of engine	258·3	
Revolutions of large dynamo	807·3	
Revolutions of small dynamo	1416·5	
Current in main circuit	11·88	ampéres
Indicated horse-power	29·02	
Net horse-power	24·06	
Electrical horse-power in main circuit	20·34	
Electrical horse-power in external circuit	19·28	
Electrical horse-power in exciting circuit	1·67	
Total electrical horse-power	22·01	
Electrical efficiency of dynamos ...	91·67	per cent.
Commercial efficiency of dynamos ...	80·29	,,
Ratio of commercial to electrical efficiency	87·57	,,

The following averages were obtained on June 18:

Duration of test	2¾	hrs.
Steam pressure	69·8	lbs.
Revolutions of engine	261·1	
Revolutions of large dynamo	818·	
Revolutions of small dynamo	1436·	
Electromotive force of two lamps ...	67·70	volts.
Current in main circuit...	11·08	ampéres.
Current in exciting circuit	7·94	,,
Indicated horse-power	24·46	
Net horse-power...	20·28	
Electrical horse-power in main circuit	17·37	
Electrical horse-power in external circuit	16·44	
Electrical horse-power in exciting circuit	1·67	
Total Electrical horse-power	19·04	
Electrical efficiency	93·94	per cent.
Commercial efficiency	81·11	,,
Ratio of commercial to electrical efficiency	86·33	,,

GENERAL ECONOMIC RESULTS.

Pounds of coal per net electrical horse-power per hour	9·56
Pounds of coal per one lamp per hour	4·90
Number of lamps per net electrical horse-power	1·95
Number of lamps per indicated horse-power ...	1·31

E. VON TAUND-SZYLL'S SELENIUM DIFFERENTIAL RECORDER.

BARON EUGEN VON TAUND-SZYLL, of Castle Frauenegg, near Graz, has obtained a patent for a peculiar combination of apparatus. It is intended for use in the working of long lines, and its principle is that only very trifling work is demanded from the weak current in the line, whilst good and distinct writing is effected by means of a powerful local current. This local current is not, however, brought into play (as in the application of an ordinary relay) by being closed and interrupted by means of an armature lever moved by the current in the line. The strength of the local current is modified for producing the telegraphic indications by altering in a suitable manner the magnitude of a resistance introduced into the circuit. This is effected not by the mechanical movement of a lever, but optically by the irradiation of a selenium cell. In reality, there are two local circuits with two selenium cells, and the writing arrangement is moved by a differential action of both the local currents. The inventor names his combined apparatus the "selenium differential recorder." It might appear more justifiable instead of this general name, and of the appelations selected for its several parts, to give the receiver the name "selenium differential writing telegraph," and to retain the name "relay" for the part which affects the local currents.

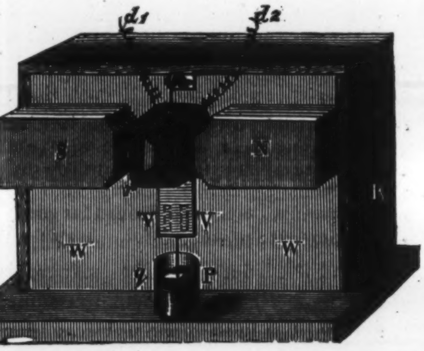

FIG. 1.

Before entering upon the detailed description of the proposed new arrangement, it may be briefly premised that the inventor requires the telegraphic current merely to move a very light screen which, according to the direction of its movement (depending on the direction of the current) allows a powerful illumination to fall upon the one or the other of the two selenium cells. In this selenium cell the luminous action is transformed into electric effect, which, lastly, with the co-operation of a steel-magnet, is transferred to the actual writing needle. The liberation of the current in the line from excess of work is therefore effected by introducing, between the telegraphic action produced directly at the place where the message is received and the writing, *three other effects*—an optical, an electric, and a magnetic. In how far these processes take place simultaneously, as the inventor supposes, and consequently become one, will have to be learnt from actual experiment. Until this has taken place, the opinion is not untenable that this plurality of actions, in addition to the movements of the current in the wire, may have an influence upon the speed of telegraphing. The probability of more distinct writing, and the consequent saving of time and trouble in reading it off, will very likely serve as a compensation, in addition to the possibility of placing the most sensitive part of the apparatus in a special locality free from any interference. In addition, the inventor anticipates, and under the above circumstances probably with justice, that his apparatus will remain to a great extent free from the phenomena of induction and other accidents of the current, and this because the full action of the local current, as required for writing, is attained only by a full illumination of the selenium cells, and consequently by a current in the line of a certain strength and duration.

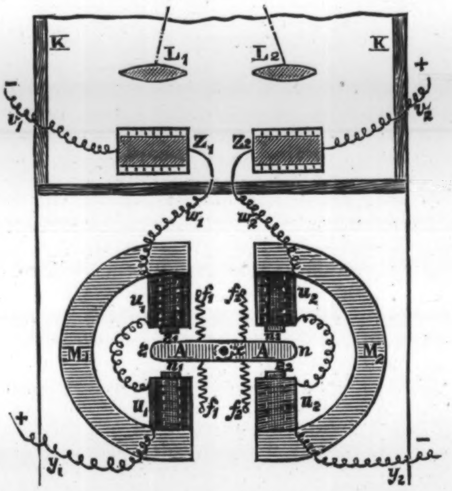

FIG. 2.

The electro-magnetic portion of the relay and the selenium cells are contained in the front compartment of a tightly closed box, K, figs. 1 and 2; if requisite these sensitive parts may be protected from air and dust by being placed under glass and preserved from changes of light by an especial protective screen; they may even be placed in a separate apartment, so that only the writing apparatus is kept in the ordinary work room.

The partition, W, separates from this front compartment a second space in which there is a powerful source of light (say an electric glow lamp), F, in fig. 3, placed close behind, W. In the screen, W, there are two slits, a_1 and a_2, through which the rays of light may pass into the front compartment of the box when these slits are not covered by the screen, V.

The relay, in its electro-magnetic arrangement, resembles Thomson's writing apparatus or syphon recorder; it contains a small bobbin frame, *r*, which is suspended movably from a cocoon thread within a very powerful magnetic field, N, S. To this frame, *r*, there is fixed a prolongation, V, pointing downwards. It has the shape of a three-sided prism, which hangs from the partition, W, in such a manner that when it is at rest in its mean position it exactly covers the two slits, a_1 and a_2, above-mentioned, and consequently hinders the rays of the glow lamp, F, between F J_1 and F J_2 from issuing through the slits, a_1 and a_2. But when the line current conveyed by the wires d_1 and d_2, traverses the bobbin of the frame, *r*, the frame, according to the direction of the current, undergoes a slight rotation to the left or the right, and at the same time it is approximated to one of the magnetic poles, S or N. But as the prolongation, V, of the frame which serves as a screen participates in these movements, it leaves in the one case the slit, a_1, and in the other the slit, a_2, open. The light can then pass from the back compartment of the box, K, into the front compartment. In the front compartment are the two lenses, L_1 and L_2, placed before the frame, *r*, and the screen, V, and before these, in the direction of the incident rays of light, there are two selenium cells, Z_1 and Z_2. If the telegraph current turns the screen, V, into the position shown by the dotted lines in fig. 3, the screen then allows the rays of light falling between F J_2 and F X_2, and coming through the slit, a_1, to pass through the lens, L_2, and the selenium cell, Z_2; if the screen turns in the other direction the rays pass through the other slit upon the left-hand lens, L_1, and the cell, Z_1. The light thus falling upon the one or the other cell diminishes its resistance, as it is well known. The regulation of the frame of the bobbin, so that when returning from a movement to a position of rest it may not pass over in the opposite direction and acquire a pendulum movement, is effected by a small plate, *p*, suspended from, V, and dipping into the cup, *q*, containing a mixture of glycerine and water.

Through the selenium cells pass the circuits of the two local batteries, perfectly separate from each other. The arrangement of the writing apparatus is sketched in fig. 2. M_1 and M_2 are two powerful horse-shoe magnets whose like poles, n_1 and n_2, s_1 and s_2, are opposed to each other diagonally. Between the poles of the steel magnets, M_1 and M_2, the steel bar magnet, A, is placed as a keeper, capable of revolving on the perpendicular axle, *x*. By means of the four spiral springs, f_1 and f_2, it can be centred in such a manner that it is equi-distant from the four poles, n_1, s_1, s_2, and n_2, whilst the four coils, u_1 and u_2, of the finest wire fixed upon the four soft iron cores on the poles of the horse-shoe magnets are traversed by the currents of the two local batteries. The two poles, n_1 and s_1, act, the one attracting and the other repelling, upon the pole, *s*, of the keeper, A, and in like manner s_2 and n_2 act upon *n*. A slight difference in the magnetic attractive and repulsive power of these four poles moves the keeper to the one or the other side. Both the strength and the accuracy of this movement can be adjusted by the four spiral springs, f_1 and f_2.

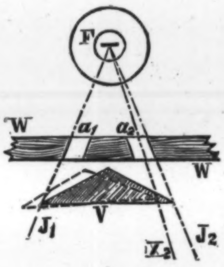

FIG. 3.

The coils, u_1, of the magnet, M_1, are connected by the wire, w_1, with the selenium cell, Z_1, as well as with the local battery introduced between v_1 and y_1, and a variable resistance.

In like manner the coils, u_2, of the magnet, M_2, are connected with the selenium cell, Z_2; a second local battery and a second variable resistance being introduced between v_2 and y_2. The two local currents, therefore, constantly traverse the respective coils, u_1 and u_2. The two variable resistances are for the purpose of compensating any changes of resistance in the selenium.

If the telegraph current traversing the line moves the coil, *r*, of the relay in such a manner that the screen is brought into the position shown by the dotted lines in fig. 3, and the light falls through the slit, a_2, upon the right-hand lens, L_2, and selenium cell, Z_2, the local current is strengthened in the circuit, v_2, w_2, y_2, and in the coils, u_2. Thereby the action of the polarised electro-magnet, M_2, upon the keeper, A, is weakened, and consequently the action of the magnet, M_1, upon the keeper, A, predominates. Hence the two poles, n_1 and s_1, of M_1 turning in the same direction, act upon the pole, *s*, of the keeper, A. The process is similar when the current turns the screen, V, in the opposite direction, in which case M_2 acts more strongly upon A than does M_1.

The keeper, A, therefore only requires to be provided with a writing arrangement, or connected with a writing apparatus in such a manner as to act directly upon the writing lever.

E. von Taund-Szyll has recently introduced into his apparatus an improvement placed at his disposal by H. M. Blackwood Price, Vice-Director of the Eastern Telegraph Company at Trieste. By this improvement the displacement of the zero-point, owing to earth currents possibly existing in the line, is rendered harmless. As this improvement is not yet patented, it is for the present a secret.—*Electrotechnische Zeitschrift.*

The *Elektro-techn. Zeitschrift* adds the following note:—As far back as the autumn of 1881 Blackwood Price reported in the TELEGRAPHIC JOURNAL on the application of two peculiarly-arranged selenium cells along with a Brown's relay for recording telegraphic characters received upon a mirror galvanometer. He had taken this subject into consideration some years previously. The circumstance that the mirror, when several deviations of the needle in the same direction follow each other, does not return between them to its zero-point, renders the recording of the deflections of the mirror very difficult. Blackwood Price could not patent his idea in England on account of the previous patent of A. Muirhead and H. A. Ch. Saunders (No. 1624, April 13th, 1881), in which (see TELEGRAPHIC JOURNAL, Vol. IX., p. 515) the indications of selenium cells were to be transferred. Paul Samuel also laid before the Academy of Belgium a proposal to write the indications of the mirror galvanometer electrochemically, making use of selenium cells and two electro-magnets. He purposed to use the Morse characters, with strokes at right angles to the length of the paper. (See *Beiblätter Wiedemann's Annalen*, 1881, Part IX., p. 683, and TELEGRAPHIC JOURNAL, Vol. IX., pp. 338 and 469.)

STEPHENS'S INDIVIDUAL TELEPHONE CALL

IN the invention illustrated by the engraving well-known principles have been applied in a simple and effective manner. A coil of wire, A, of not more than ten ohms resistance, is supported on a pivot, B, journaled in a frame, C, which also supports a horse-shoe magnet, D, whose poles are surrounded by the coil, A. A pendulum, E, secured to a pivot, B, is weighted so as to have a period of oscillation different from any other in the same circuit. The pivot, B, supports a detent, upon which rests the free end of an arm, F. The coil, A, is in the line circuit, which is connected with the outside terminals; the lever, F, and the post, G, under it, form the terminals of a circuit connected with the inner terminals.

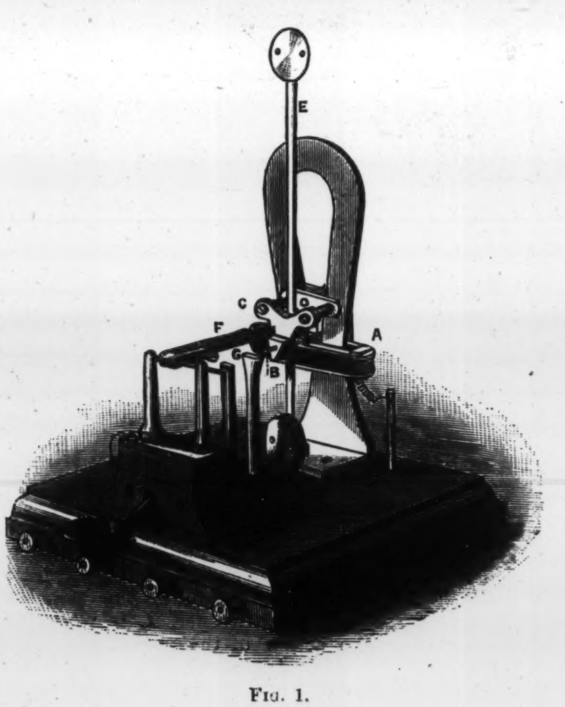

FIG. 1.

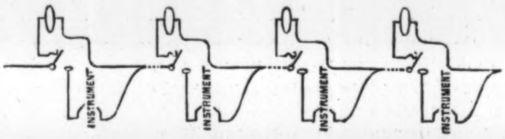

FIG. 2.

It will be seen that, if an alternating current is sent over the telephone wire, the alternating positive and negative impulse traversing the coil, A, in times consonant with the period of the pendulum, E, the pendulum will begin to oscillate, and the swing will increase until its amplitude is so great as to turn the detent on the end of the pivot, B, sufficiently to liberate the lever, F, and allow it to drop on the post, G, and complete the local circuit, ringing the bell, or giving other audible or visible signal. After the signal has been given, the lever, F, may be replaced in its position on the detent by means of the key projecting from the front of the instrument.

The current may be sent by hand, taking the time by the swing of the pendulum adjusted to the instrument which it is desired to actuate; or an electrical impulse may be transmitted automatically by pendulum or metronome, the bob of which can be readily adjusted so as to influence any particular instrument on the line. It will be seen by reference to fig. 2 that normally the electro-dynamic coils alone are in the circuit.

An addition to the instrument, which is not shown, renders it impossible for one subscriber to listen to the message being transmitted to another.

By means of this simple instrument a small town at a considerable distance from a large telephonic centre could secure connection with the system by means of one wire, without any expense whatever for a central office.

COPPER RESISTANCE BY FALSE ZERO METHOD.

THE writer congratulates himself on having drawn from Mr. Rimington such a valuable contribution to electrical literature as his paper on the False Zero Test published in the issue of this journal for November 7th.

Mr. Rimington points out that the diagrams and figures in the original paper (*vide* REVIEW, 17th October) would be perfectly correct if only an electrometer or a galvanometer of *very* high resistance were employed, thus bringing point E (*vide* former diagrams) practically to zero. He then proceeds to review the whole test under the three several conditions, viz., the noting of the false zero, the application of C to L and ditto Z to L, showing that the differences of potential at the galvanometer terminals (G being taken as equal each of the four bridge arms) are in all three cases equal to $\frac{1}{4}$ cell, for

Firstly ... $\frac{3}{8} - \frac{1}{8} = \frac{2}{8} = \frac{1}{4}$ cell,
Secondly... $1\frac{3}{8} - 1\frac{1}{8} = \frac{2}{8} = \frac{1}{4}$ cell,
Thirdly ... $\frac{7}{8} - \frac{5}{8} = \frac{2}{8} = \frac{1}{4}$ cell,

instead of

Firstly ... $\frac{1}{2} - 0 = \frac{1}{2}$ cell,
Secondly... $1\frac{1}{2} - 1 = \frac{1}{2}$ cell,
Thirdly ... $1 - \frac{1}{2} = \frac{1}{2}$ cell,

as in the original paper, where the correction for galvanometer current was not applied. The writer, notwithstanding that his diagram fig. 5 represents potential at E as zero, cannot plead guilty to ever having imagined that the potential at E (*vide* fig. 5, original paper, ELECTRICAL REVIEW, 17th October), between which point and earth there is a current passing from G through a resistance $\frac{\text{BE} \times \text{EC}}{\text{BE} + \text{EC}}$, could really be zero, albeit, no reservation to that effect having been embodied in the communication in question, Mr. Rimington was perfectly justified in so presuming. The omission with its consequent inexactness was, however, not overlooked; but as the diagrams were designed not so much as a complete geometrical proof of the test as a plain illustration of the necessity for R to be to x what m is to m' during the noting of false zero, the writer refrained from touching upon a correction which, whilst rendering the diagrams more complicated, would not affect the essential rule there for the first time plainly enunciated to cable staff-learners, namely, that when noting a false zero previous to a bridge test, the proportion $m : m' :: \text{R} : x$ must exist. It is fortunate that the writer did not broach the subject of the correction, as Mr. Rimington's paper is more highly "finished" than anything the former could have produced. It is a matter for regret, however, that Mr. Rimington has not given a purely geometrical proof with a geometrical illustration of G included.

Figs. 2 and 3 show the method by which the author of the original paper, when attempting the correction, arrived at what appear to be values identical with those obtained by Mr. Rimington; he is, however, not satisfied with the same, and hopes, with the kind permission of the editor of this REVIEW, to hear again from Mr. Rimington, being prompted in thus encroaching on these hospitable columns by the genuine interest taken in this matter by colleagues at more than one cable station.

N.B.—Figs. 2 and 3 were drawn on the occasion of the writing of the original communication, but the perusal of Mr. Rimington's paper has greatly aided the writer in applying the same.

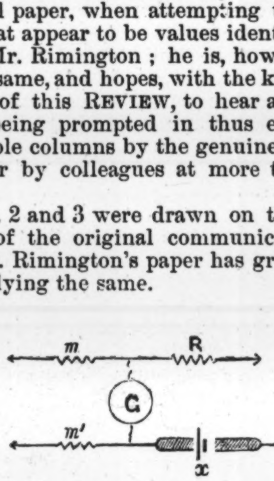

FIG. 1.

In fig. 1, let $m = m' = \text{R} = x = \text{G} = 1000^\omega$; let earth current be = 1 cell.

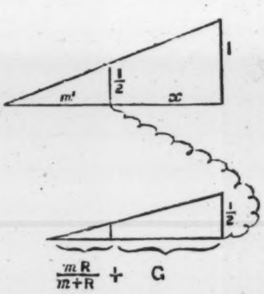

FIG. 2.

Fig. 1 may be geometrically illustrated, as in fig. 2, which may again be condensed into fig. 3.

$$\text{R being} = \frac{m'\left(\text{G} + \frac{m\ \text{R}}{m\ +\ \text{R}}\right)}{m' + \left(\text{G} + \frac{m\ \text{R}}{m\ +\ \text{R}}\right)} = 600^\omega$$

so that $x + \text{R} = 1000 + 600 = 1600^\omega$. Total potential at $\text{V} = \frac{1}{2}$ cell. A straight line joining points a and b intersects perpendicular V into two parts, namely

$$v = \tfrac{3}{4} \text{ of } \tfrac{1}{2} \text{ cell} = \tfrac{3}{8} \text{ cell},$$

and

$$v' = \tfrac{1}{4} \text{ of } \tfrac{1}{2} \text{ cell} = \tfrac{1}{8} \text{ cell},$$

these being the potentials at the galvanometer terminals productive of a deflection proportional to the difference of potential $= v - v' = \frac{3}{8} - \frac{1}{8} = \frac{2}{8} = \frac{1}{4}$ cell.

We then find that before application of testing current, $v = \frac{3}{8}$ cell and $v' = \frac{1}{8}$ cell.

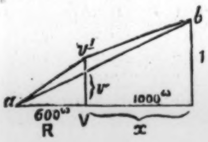

FIG. 3.

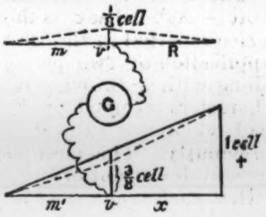

FIG. 4.

Vide fig. 4, the limits of corrected potentials are shown by dotted lines, black lines forming the diagram, as given in the original paper.

If we now apply the same correction to the two other diagrams, viz., those showing electrical conditions with opposite currents, thereby

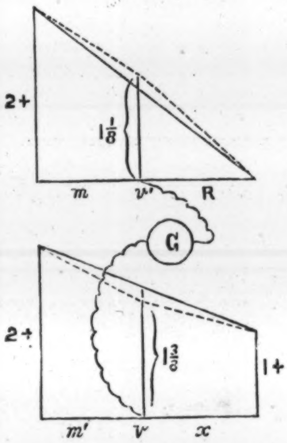

FIG. 5.

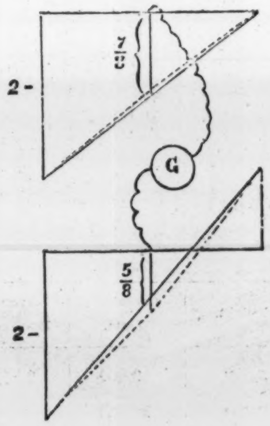

FIG. 6.

Firstly, in fig. 5, adding $\frac{1}{8}$ cell to v' whilst deducting same from v.

Secondly, in fig. 6, deducting $\frac{1}{8}$ from v', and adding the same to *v*. On measuring out, we obtain as potential values at galvanometer terminals in the three cases

1.— $\frac{3}{8}$ — $\frac{1}{8} = \frac{1}{4}$ cell.
2.—$1\frac{3}{8} - 1\frac{1}{8} = \frac{1}{4}$ cell.
3.— $\frac{7}{8}$ — $\frac{5}{8} = \frac{1}{4}$ cell.

these being the figures which Mr. Rimington obtains by calculation.

The dotted lines in the diagrams are also identical with the variation of potential throughout the bridge system as drawn by Mr. Rimington from his calculated results.

The writer must express regret at an error, due to a slip in logarithms, having crept into his former note: see page 331 of the REVIEW for October 17th. Dresing's formula—

$$\sqrt{1451{\cdot}5 \times 710{\cdot}5} = 10155^{\omega} \textit{ not } 10313^{\omega}.$$

ED. RAYMOND-BARKER.

Brazilian Submarine Telegraphs,
Madeira.

THE RECENT DYNAMO TESTS AT PHILADELPHIA.

MR. E. WESTON, the inventor, has written to the New York *Electrical Review* upon this subject as follows:—

There seems to have been some confusion in the mind of the writer of the article on "The Recent Tests of Dynamos at Philadelphia,"‡ published in your issue of November 14th, 1885, in regard to the relative commercial efficiencies of the Edison and Weston machines.

He states that "when we come to consider the point of commercial efficiencies we find the Edison machines leading their rivals by a small amount."

Now, that statement is not correct, and if the writer of the article will carefully study the official report he will find nothing there to warrant it. As a matter of fact, all the tests prove just the contrary.

By examining the table of total and commercial efficiencies on page 8, it will be found that the efficiency of the large machines of each type is slightly higher than that of the smaller ones of the same type. That is to say, the efficiency increases slightly as the capacity of conversion increases. For example, the capacity of conversion of the Edison No. 4 machine is 10,000 watts. The average total efficiency of this machine is 90·31, and its average commercial efficiency, 83·97. The capacity of conversion of the Edison No. 10 machine is 25,000 watts, its average total efficiency 90·25, and its average commercial efficiency 85·37, a difference of nearly 1·5 per cent. in favour of the larger machine. Comparing any of my machines we find the same rule holds good. For example, the 6 M. machine has a capacity of conversion of 9,600 watts, an average total efficiency of 93·84, and an average commercial efficiency of 87·26. The 6 W.I. machine has a capacity of conversion of 13,000 watts, an average total efficiency of 93·70, and an average commercial efficiency of 87·86.

These facts are very clearly shown in Table I.

From this it follows that it is unfair to compare two machines of widely different capacities of conversion.

Assuming such a comparison fair, however, what is the relative position of the two machines?

An inspection of the table proves beyond a doubt that the Weston machines of equal or *even less* capacity are more efficient than the Edison machines.

There is no better proof of this than is afforded by a comparison of my 6 W.I. machine, which has a capacity of conversion of 13,000 watts, with the Edison No. 10, which has a capacity of conversion of 25,000 watts. The Edison No. 10 machine had nearly double the capacity of my 6 W.I. machine, and yet mine considerably exceeded it in efficiency, as the table clearly shows. In regard to the test of the Edison No. 20 machine, I would state that had I known that the committee intended to publish the results of the tests of this machine, *which were not conducted in accordance with the provisions of the code*, I should have insisted upon their testing one of my machines of nearly equal capacity.

The committee seem to have gotten over the difficulty in the matter of the code in this case, by marking the test "Unofficial," but they have nevertheless given this unofficial test the authority of their endorsement in the following words:

"In the table the full load efficiencies of the Edison No. 20 dynamo are marked 'unofficial,' because the preliminary run was not in conformity with the code, *not because there is any reason to mistrust the results.*"

I leave it to them, therefore, to explain the difference

TABLE I.—TABLE OF EFFICIENCIES.

	Volts.	Amperes.	Capacity in Watts.	Weight.	Total Efficiencies.					Commercial Efficiencies.				
					Full Load.	¾ Load.	½ Load.	¼ Load.	Average.	Full Load.	¾ Load.	½ Load.	¼ Load.	Average.
Edison, No. 4	125	80	10,000	1,470	94·45	93·26	89·65	83·89	90·31	88·44	87·40	83·65	76·40	83·97
„ 5*	125	100	12,500	2,475	96·01	...	...	...	...	89·19	...	...	...	...
„ 10	125	200	25,000	4,710	94·68	92·44	90·55	83·32	90·25	89·61	88·23	86·12	77·53	85·37
„ 20*	125	400	50,000	8,331	96·65†	95·46	92·77	88·80	93·42	91·96†	91·19	88·93	83·76	88·94
Weston, 6 M.	120	80	9,600	2,000	94·67	96·53	94·84	89·33	93·84	87·66	90·10	89·23	82·87	87·26
„ 7 M.	160	125	20,000	3,300	96·56	96·38	94·84	90·08	94·46	89·37	90·49	89·57	84·37	88·45
„ 6 W.I.	130	100	13,000	2,100	96·20	94·06	92·89	91·64	93·70	90·85	89·22	87·32	84·07	87·86

*Armature insulation gave way. †Unofficial.

TABLE II.

WESTON.					EDISON.			
No. of Machine.	Weight.	Capacity in Watts.	Average Total Efficiencies.	Average Commercial Efficiencies.		Average Total Efficiencies.	Capacity in Watts.	Weight.	No. of Machine.
6 M.	2,000	9,600	93·84	87·26	83·97	90·31	10,000	1,470	4
6 W.I.	2,100	13,000	93·70	87·86	...	...	12,500	2,475	*5
7 M.	3,300	20,000	94·46	88·45	85·37	90·25	25,000	4,710	10
...	...	...	...	...	†88·94	†93·42	50,000	8,331	*20

*Armature insulation gave way. †Unofficial.

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‡ See also our issues of November 21st and 28th.—EDS. ELEC. REV.

between this "unofficial" test with an "official" endorsement of its correctness, and any of the other, specifically official, tests. It seems to me there is here a distinction without a difference. Is it not equivalent to saying that this is an *official* unofficial test? I think so.

But taking this No. 20 Edison machine, which had a capacity of 50,000 watts, the tests of which were unofficially (?) injected into the series, how does it stand when compared with my 7 M. machine, which has a capacity of only two-fifths that of the Edison machine? It had the advantage of it *by less than one-half of one per cent.*

The respective positions of the machines tested are as shown in Table II.

A few words in regard to the proper way of arriving at the true commercial efficiency of the machines.

The writer of the article seems to think that the efficiency under full load gives the true commercial efficiency. That cannot be, because machines in practical use are generally run with widely varying loads. The competitors realised this fact, and they were both anxious that the tests should be conducted under conditions as nearly identical with the conditions of practical use as it was possible to get without too much labour.

For this purpose they agreed that four tests for the efficiency of each machine should be made, viz.: one with full load; one with three-quarter load; one with half load, and one with quarter load.

The first of these tests was to continue for at least five hours after the machine had reached a maximum constant temperature. The remaining three tests were to be made as soon as the machine had reached a maximum constant temperature under the given load.

See clauses 9, 10, 11 and 13 of Section 4 of the Code.

Now is it likely that the competitors or the committee would have spent their time in making such a series of graded tests if the true commercial efficiency could have been determined by a single test under full load? Most assuredly not.

The true commercial efficiency is no doubt much nearer the average of the four tests than the efficiency of the machine as shown by full load tests, consequently comparison of efficiency of the machines ought to be made upon the first-named basis.

THE ELECTRIC LIGHTING OF THE CENTRAL STATION, GLASGOW.

As the lighting up by electricity of the Central Station, Glasgow, is perhaps the largest installation of its kind in the United Kingdom, it may not be uninteresting to our readers if we to-day present them with a fuller account than we were able to do in our issue of the 28th ult.

The Directors of the Caledonian Railway Company having determined to exchange the gas light for its fairer rival, the electric light, entrusted the carrying out of their requirements to Mr. Andrew S. Dunn, their telegraph engineer and superintendent.

In the spring of this year, Mr. Dunn fitted up an extensive permanent electric light installation at the Company's Docks at Grangemouth, and as the plant laid down there had worked most satisfactorily, he decided to provide engine and dynamo power of a somewhat similar kind for the Central Station. The engine used is of the horizontal type, 70 H.P. nominal, carrying a 10 feet fly-wheel. It is placed upon a concrete foundation at the end of one of the large arches below the platforms, and, whilst the speed of the engine itself is 44 revolutions per minute, that of the dynamos is brought up to 900 by means of two countershaftings.

The dynamo platform is also bedded upon cement, and has been most carefully prepared for solidity and insulation. Here two Brush No. 7 dynamos, with laminated armatures, are firmly secured, and driven by means of composite belts formed of canvas with gutta percha forced into the interstices. These belts, which are both strong and light, possess good gripping powers, having a thoroughly smooth run, and do not stretch. They are manufactured by Messrs. R. and J. Dick, of Glasgow. By the improvement made in laminating their armatures, the Brush machines, which formerly fed only 16 2,000 C.P. lights, are now capable of lighting 25 of the same capacity. Two such dynamos are used for supplying the 50 lamps in the station with current. There are also two Gramme dynamos on the platform, each of which feeds a 4,000 C.P. lamp in the yard of the station. Within the station proper are 42 lamps, which are hung about 16 feet above the floor, and some 25 yards apart. The booking hall is brilliant with three, and the carriage entrance and verandah has two, the hotel doorway being decorated with one, whilst the bridge across Argyle Street has two lamps. In running the leads, which were $\frac{7}{15}$ strand high conductivity copper, insulated and braided, special care was paid to their insulation. The wires were bound to double shed insulators fixed in oak arms, bolted to wooden stools, wedged into the troughs of the iron girders, not one of which was bored. The old gas pendants have been utilised, being shortened, and the lamps hang from them, within reach for trimming from travelling steps, so that hoisting gear and counterpoise weights are not necessary. Another peculiarity is that the circuits have been run without a joint, as when terminating, sufficient wire was left after binding in and soldering to reach down to the lamps. The results of these precautions are that the circuit gives the highest insulation, and is very low for copper resistance. The lamps, fitted with alabastrine globes, wire netted, are of a most handsome appearance. Their wonderful steadiness, which is the subject of much favorable comment, is largely due to a new form of coil winding lately introduced by the Brush Corporation. The general illuminating effect is exceedingly pleasing, and the softness of the light, as well as the absence of heavy shadows, is greatly appreciated. The installation has now run for nine days without the slightest hitch, and the effect upon electric lighting generally is of a most favourable character, and the many enquiries made in connection with it, proves that there is a wide spread desire for electric lighting if confidence in it can once more be restored.

For the hotel there is an Edison-Hopkinson dynamo, driven by a 7 H.P. nominal, horizontal engine. Nearly 200 20-C.P. incandescent lamps are fed by it. Many of these lamps are in use in the lower part of the hotel during the day, and the small engine is chiefly required then, as when the large engine starts for the station lights about dusk, it also works the hotel section of lights by means of a clutch throwing on a back drive belt.

It may be added that in connection with the Brush dynamos and lamps, there are fitted up two Brush regulators, so that should any extra speed of the steam engine generate more current than is required, or some lamps go out unexpectedly, resistance will at once be inserted into the fields of the dynamos, and less current be produced. An element of safety and protection is thus introduced, the want of which has been disastrous in its effects at some recent installations of lighting.

Both of the engines named were built and fixed by Mr. John Bennie, of the Star Engine Works, Glasgow.

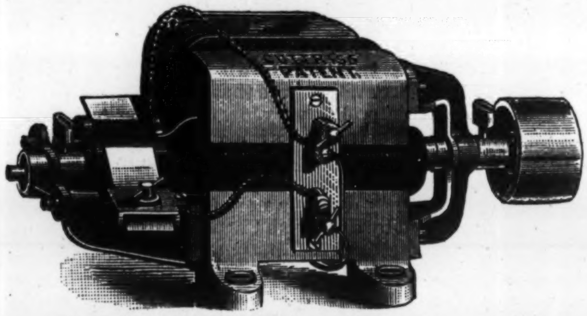
Blowpipe for Soldering Electric Light Wires.—To obviate the delay caused in the erection and repair of electric light lines by the premature cooling of soldering irons, and bring the direct flame to bear upon the joint, an apparatus has recently been devised by the Illinois Street Gas Company, of Chicago. It consists of a reservoir for holding gasoline, a force pump and a burner. A few strokes of the pump create and maintain a pressure on the gasoline and force it out of the burner in a fine spray, which generates an exceedingly hot flame, that can be regulated to any size.

SMALL DYNAMOS.

MESSRS. CUTTRISS & CO., of Leeds, are now manufacturing a small type of dynamo for special purposes. It is called the Eclipse, and is an improved form of their well known student's and laboratory dynamo, which has met with marked success, numbers of them being in use in various parts of the United Kingdom and the Continent.

It has been the aim of Messrs. Cuttriss to design a machine suitable for small installations of from six to twenty incandescent lights, special regard having been paid to simplicity of construction, efficiency, and cheapness; the result is what appears to be a thoroughly reliable and suitable machine for such work as the lighting of the offices of mills and factories, and similar work, where the expense of a large installation is not considered advisable.

The dynamo is exceedingly simple in construction, there being no parts which cannot be repaired, if required, by any mechanic of ordinary intelligence. The shaft is made of steel, and works in long gun-metal bearings. The iron core of the armature is laminated by being built up of a number of thin sheet iron sections, and the wire is wound round it in one length, the ends being joined to a commutator consisting of only two sections. When the machine is running with the full number of lamps, no sparking whatever can be observed at the commutator, and the brushes being kept to their work by spiral springs, with only just sufficient pressure to ensure good contact, the wear after continued use is quite inappreciable, which we consider a great point in its favour, as in the majority of small machines, the commutator and brushes form the weakest part of the machine, being soon worn away by excessive pressure and sparking.



Considering the light weight of the dynamos, the results obtained must be deemed remarkably good, as a machine weighing only 87 lbs. illuminates 12 20-C.P. lamps. The manufacturers are at present making three sizes, which respectively illuminate 6, 12, and 20 20-C.P. lamps, and they inform us that the above are the actual working loads of the machines for continuous work, and not merely the numbers which the machines are capable of lighting for a short time.

We have seen one of the twelve light machines at work, and, so far as we could judge, these dynamos are excellently well made and finished, and will no doubt meet with as large a sale as they deserve.

Army Telegraphists.—The medals awarded to the 3rd Battalian Grenadier Guards and the Army Postal and Telegraph Corps attached to the 24th Middlesex (Post Office) Rifle Volunteers, for service in the late campaign in the Soudan, were last week presented on the parade ground of Wellington Barracks. The Grenadier Guards, who were under the command of Colonel Thynne, C.B., and the Post Office Rifles, under Colonel Du Plat Taylor, were addressed by Colonel Philip Smith, who expressed the gratification he felt in welcoming back Major Sturgeon and the non-commissioned officers and men who had formed part of the Postal and Telegraph Corps, and who had rendered the State a most important and valuable service.

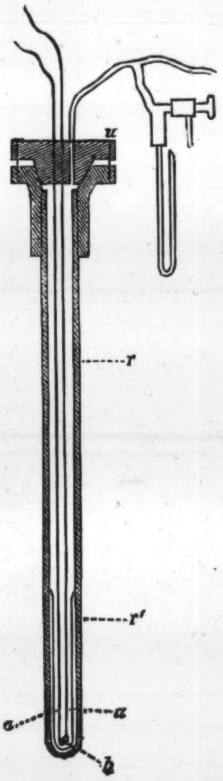
ON THE ELECTRIC RESISTANCE OF COPPER AT VERY LOW TEMPERATURES.

By SIGMUND VON WROBLEWSKI.

AS early as 1858 Clausius, when discussing the experiments of Arndtsen on the electric resistance of the metals at different temperatures made the remark that the coefficients of temperature here met with lie very close to the coefficients of the expansion of permanent gases. If we neglect the quadratic member occurring in iron, and if we take the mean of all the first coefficients we obtain for the resistance w_θ at the temperature θ, compared with the resistance w_0 at freezing point, the formula

$$w_\theta = w_0 \, (1 + 0{\cdot}00366{\cdot}\theta).$$

Hence it would follow that the resistance of the simple metals in the solid state is closely proportional to the absolute temperature. If, therefore, we were in a position to reduce the experimental temperature to the absolute zero, we should be able to reduce the electric resistance of the metals to nil. In other words the electric conductivity of metals at — 273° C. would be infinitely great.



Although the subsequent determinations of Matthiesen and Von Bosc rendered the simplicity of this connection between absolute temperature and electric resistance improbable, the observation of Clausius seemed to me of sufficient interest and importance to be submitted to an experimental investigation.

I undertook, therefore, as a preliminary, to examine the resistance of copper down to the minimum temperature which can be reached by means of liquid nitrogen.

The copper wire employed was 0·04 millimetre in diameter, and was coated with a double layer of white silk. The purity of the copper was not examined, but the firm who supplied the wire guaranteed it as of 98 per cent. conductivity.

The measurements were effected according to the well-known Wheatstone-Kirchhoff method. The resistances were determined by means of a Siemens resistance box. As the temperatures were selected the following :—

1. Boiling point of water.
2. Ordinary temperature of rooms (+ 21 to + 26° C.).
3. Melting point of ice.
4. Boiling point of ethylene at the pressure of the atmosphere (— 103° C.).
5. Critical temperature of nitrogen (— 146° C.).
6. Boiling point of nitrogen at atmospheric pressure (— 193° C.).
7. Temperature not far from the freezing point of nitrogen (— 203° C., probably — 200° to — 202° C.).

No intermediate temperatures could be taken, as the galvanometer with which these temperatures were measured had been applied in the Wheatstone bridge.

For the experiments in liquid nitrogen was used the apparatus which I described at length in the memoir, "On the Use of Boiling Oxygen, Nitrogen, Carbon, Non-oxide and Atmospheric Air as Refrigerants" (*Wien Akat. Berichte*, Vol. XCI., pp. 667–711). The figure here given shows only that part of the apparatus which is necessary for understanding the method.

Through the cover, *u*, of the apparatus were introduced two copper wires of 0·9 mm. perfectly insulated, and were left below so long that their ends, *a*, *a*, reached to about 3 centimetres from the bottom of the test tube, *r*′, placed within the glass tube, *r*.

After the complete insulation of the two wires from the cover, *u*, had been ascertained by galvanometric measurements, the liquid nitrogen was examined as to its conductivity. For this purpose this gas was liquified so that both copper wires plunged into the liquid.

The liquid nitrogen was found to be an insulator.

The portion of the copper wire in question was then wound upon a very thin glass tube 7 mm. in length and 3·5 mm. in thickness to form the bobbin, *b*; it was tied together with silk threads, and was then soldered with both ends to the copper wires, *a*, *a*. As the measuring bridge was at a distance of several metres from the liquifying apparatus the resistance of all the conducting wires up to the place where the bobbin was soldered on varied from 0·3 to 0·274 Siemens units according to the thickness of the wire. The resistance of the coil to be determined was ascertained by comparison with three different resistances. The determinations at 0° C. were effected by placing the bobbin in ice-cold ether. For the production of the lowest temperature the nitrogen was evaporated so far that its tension amounted only to the pressure of 10 to 6 centimetres of mercury.

In the subjoined tables

Θ signifies the temperature,
w the resistance of the bobbin in Siemens units,
a the coefficient calculated from the formula

$$a = \frac{w_\theta - w_{\theta'}}{w_0\,(\theta - \theta')}$$

where w_0 signifies the resistance at 0° C. and w_θ and w_θ resistances at two adjacent temperatures Θ and Θ'.

BOBBIN No. 1.

Length of wire about 45 centimetres.

Θ	*w*	*a*
+ 100° C.	5·174	
+ 21·4	3·934	0·004365
± 0	3·614	0·004136
— 103	2·073	0·00414
— 146	1·360	0·004588
— 193	0·580	0·004592
— 200	0·414	0·006562

BOBBIN No. 2.

Length of wire about the same.

Θ	*w*	*a*
+ 100° C.	5·26	
± 0	3·687	0·004266
— 103	2·131	0·004097
— 146	1·427	0·004441
— 193	0·6055	0·004741

BOBBIN No. 3.

Wire above two metres in length. The bobbin soldered to two copper wires 2 millimetres in thickness.

Θ	*w*	*a*
+ 23·75° C.	19·251	
± 0	17·559	0·004057
— 103	9·848	0·004263
— 146	6·749	0·004104
— 193	2·731	0·004869
— 201	1·651	0·007688

The same bobbin soldered to copper wires of 0·9 millimetres in thickness.

Θ	*w*	*a*
+ 25° C.	19·262	
± 0	17·489	0·004056
— 103	9·769	0·004286
— 146	6·738	0·004030
— 193	2·754	0·004847
— 201	1·655	0·007855

These figures represent the mean values of several series of observations. I could not perceive any permanent alteration of resistance in the bobbin by refrigeration to — 200° C.

If these numbers are compared, it will be seen that the electric resistance of copper falls much more rapidly than the absolute temperature and approximates to nil at a point not far from the temperatures reached by the evaporation of liquified nitrogen. If the results are plotted out graphically it will be seen that this must occur long before reaching the absolute nil.

I am far from supposing that I have already realised the full refrigerating effect which may be reached from the liquified gases, and it seems to me not improbable—especially if it is found practicable to obtain hydrogen in large quantities in the form of a static liquid—that we may find copper to be a conductor of infinitely small resistance.

Such a conductor would have very remarkable properties. Electricity would be conveyed in it without any liberation of heat, and the useful effect on transporting power electrically in such a conductor would approach unity. Although for the present no practical results can thus be obtained it is yet important to show that the above intimations do not belong to the realms of imagination, but are capable of being realised with the means offered us by the liquifaction of the gases.—*Repertorium der Physik.*

Defrauding Workmen.—Mr. William Wilson will retire into strict privacy for a period of five years, and anticipates being fully occupied during that period in work for the national benefit. The cause which has immediately led to this proceeding on his part was the belief in the mind of the magistrate that it would conduce to the general good were Mr. Wilson for a time prevented from obtaining further sums of money from boys and young men under the pretence that he will secure them employment with an electric lighting company.

THE STANDARD OF WHITE LIGHT.

Report of the Committee, consisting of Prof. G. FORBES, Captain ABNEY, Dr. J. HOPKINSON, Prof. W. G. ADAMS, Prof. G. C. FOSTER, Lord RAYLEIGH, Mr. PREECE, Prof. SCHUSTER, Prof. DEWAR, Mr. A. VERNON HARCOURT, and Prof. AYRTON, *appointed by the British Association. Drawn up by* Prof. G. FORBES (*Secretary*).

THE experimental work of the Committee during the past year has not been extensive, as they had no funds at their disposal for experimental research, and they have been chiefly occupied with reviewing what has been done in the past and laying plans for future operations.

Lord Rayleigh has constructed an instrument which he calls a monochromatic telescope, by means of which the illuminated screens of a photometer may be examined, allowing light only of one definite colour to pass. It was hoped by Lord Rayleigh that experiment might show that, with some suitably chosen colour, this instrument, used with any ordinary photometer, would, in comparing lights of different intensities and temperatures, give to each a candle-power which would be sufficiently accurate to represent for commercial purposes the intensity of the light. The secretary has made some experiments at the Society of Arts, where he was kindly permitted to use the secondary batteries and glow lamps; but the results so far are not definite enough to justify their publication.

Mr. Vernon Harcourt has been engaged on an investigation on the barometrical correction to his pentane standard, and on another concerning the possibility of using lamp shades as a protection from air currents. His researches are communicated independently to the meeting.

Captain Abney and Colonel Festing have continued their observations on the intensity of radiations of different wave-lengths from incandescent carbon and platinum filaments at different temperatures, which will go far to assist the Committee in their work.

Other isolated experiments have been made by members of the Committee, which will be published in due course.

Most of the members have examined the experiments of the Trinity Board at the South Foreland.

Existing Standards.

A consideration of existing standards convinces the Committee that the standard candle, as defined by Act of Parliament, is not in any sense of the word a standard, The French "bec Carcel" is also liable to variations; and with regard to the molten platinum standard of Violle, it seems that the difficulty of applying it is so great as to render its general adoption almost impossible.

With regard to the so-called standard candle, the spermaceti employed is not a definite chemical substance, and is mixed with other materials, and the constitution of the wick is not sufficiently well defined. Hence it is notorious that interested parties may prepare candles conforming to the definitions of the Act which shall favour either the producer or consumer to a serious extent. In view of these defects of the standard candle, it is a matter of great importance that a standard of light should be chosen which is more certain in its indications.

The Committee have looked into the merits of different proposed standards, and the majority feel satisfied that, for all the present commercial requirements, the pentane standard of Mr. Vernon Harcourt—since it has no wick and consumes a material of definite chemical composition—when properly defined, is an accurate and convenient standard, and gives more accurately than the so-called standard candle an illumination equal to that which was intended when the Act was framed.

Yet the Committee, while desiring to impress the Board of Trade and the public with these views, do not feel inclined at present to recommend the adoption of any standard for universal adoption until, further information on radiation having been obtained from experiment, they may learn whether or not it may be possible to propose an absolute standard, founded, like electrical and other standards, on fundamental units of measurement—a standard which, for these reasons, would be acceptable to all civilised nations. They are, however, inclined to look upon the pentane lamp as an accurate means of obtaining an illumination to replace the so-called standard candle.

Proposed Experimental Researches.

Radiation is measured as a rate of doing work, and consequently radiation might be measured in watts. The illumination (or luminous effect of radiation) depends partly upon the eye, and is a certain function of the total radiation. This function depends upon the wave-length of the radiation, or on the different wave-lengths of which the radiation, if it be compound, is composed. This function of the radiation perceived by the eye is partly subjective, and varies with radiations of different wave-lengths and with different eyes. Thus the illumination cannot, like the radiation, be expressed directly in absolute measurement. But the connection between the illumination and the radiation can be determined from a large number of experiments with a large number of eyes, so as to get the value of the function for the normal human eye. This function, however, is constant only for one source of light, or, it may be, for sources of light of the same temperature. It appears, then, that, in the first instance at least, a standard should be defined as being made of a definite material at a special temperature.

The energy required to produce a certain radiation in the case of a thin filament of carbon or platinum-iridium heated by the passage of an electric current can be easily measured by the ordinary electric methods, and the radiation may be measured by a thermopile or a bolometer, which itself can be standardised by measuring the radiation from a definite surface at 100° C., compared with the same at 0° C. The electric method measures the absorption of energy; the thermopile measures the total radiation. These two are identical if no energy is wasted in convection within the glass bulb of the lamp, by reflection and absorption of the glass, and by conduction from the terminals of the filament. Captain Abney and Colonel Festing have come to the conclusion that there is no sensible loss from these causes. The Committee propose to investigate this further. This constitutes a first research.

No research is necessary to prove that with a constant temperature of a given filament the luminosity is proportional to the radiation, because each of these depends only upon the amount of surface of the radiating filament. It will be necessary, however, to examine whether with different filaments it be possible to maintain them at such temperatures as shall make the illumination of each proportional to the radiation. This will be the case if spectrum curves, giving the intensity of radiation in terms of the wave-length when made out for the different sources of light, are of the same form. Thus a second research must be undertaken to discover whether the infinite number of spectrum radiation curves, which can be obtained from a carbon filament by varying the current, are identical in form when the filament is changed, but the material remains, so far as possible, of constant composition.

It will be an object for a later research to determine whether, when the radiation spectrum curve of any source of light has been mapped, a similar curve can be found among the infinite number of curves which can be obtained from a single filament.

The next step proposed is to examine a large number of carbon, or of platinum-iridium filaments, and to find whether the radiation spectrum curve of different specimens of the same material is identical when the resistance is changed in all to x times the resistance at 0° C. If this law be true a measurement of the resistance of the filament would be a convenient statement of the nature of the radiation curve. If, then, a number of filaments were thus tested to give the same radiation spectrum curve, their luminosities would in all cases be proportional to their radiations, or (if there be no loss in convection, conduction, absorption, and reflection) proportional to the electrical energies consumed.

Thus it might be hoped to establish a standard of white light, and to define it somewhat in the following manner:—*A unit of light is obtained from a straight carbon filament, in the direction at right angles to the middle of the filament, when the resistance of the filament is one-half of its resistance at 0° C., and when it consumes* 10^9 *C.G.S. units of electrical energy per second.*

Since Mr. Swan has taught us how to make carbon filaments of constant section by passing the material of which they are composed through a die, it is conceivable that another absolute standard should be possible—viz., a carbon filament of circular section, with a surface, say, $\frac{1}{100}$ sq. centimètre, and consuming, say, 10^9 C.G.S. units of energy per second.

Whether such standards are possible or not depends upon the experiments of the Committee. The probability of success is sufficient to render these experiments desirable.

Proposed Later Experimental Researches.

Should these hopes be realised, and an absolute standard of white light thus obtained of a character which would commend it to the civilised world, it would then become an object of the Committee to find the ratio of luminosity when the radiation spectrum curve of the standard filament is varied by varying the current, and consequently the resistance of the filament.

Thus, by a large number of subjective experiments on human eyes, a multiplier would be found to express the illumination from the standard lamp, with each degree of resistance of the filament.

A research previously hinted at would then be undertaken—viz., to find whether the radiation spectrum curves of all sources of illumination agree with one or other of the curves of the standard filament. It is not improbable that this should be the case, except for the high temperature of the electric arc.

Should this be found to be true, then photometry would be very accurate, and the process would be as follows: *Adjust the standard filament until its radiation spectrum curve is similar to that of the light to be compared.* (This would probably be best done by observing the wave-length of the maximum radiation, or by observing equal altitudes on either side of the maximum, the instruments used being a spectroscope and a line thermopile or a bolometer.) The total radiation of each is then measured at equal distances by the thermopile. The resistance of the filament is measured, and its intensity in terms of the unit of white light obtained therefrom by the previous research. The luminosity of the compared source of light is then obtained directly.

The Committee desire to be reappointed, and to enable them to carry out the researches indicated they ask for a grant of £30.

Telegraph Revenue.—The receipts on the telegraph service from April 1st to December 5th last were £1,210,000 against £1,220,000 received from April 1st to December 5th, 1884.

SUBMARINE CABLES IN WAR.

(BY A CORRESPONDENT OF THE "TIMES.")

IN January, 1850, the French Government conceded to an English company the right to establish telegraph communication across the Channel by a submarine cable. Not till August, 1857, however, was the first attempt made to bridge the Atlantic, when the old *Agamemnon*, since replaced, and the United States frigate *Niagara*, started from Valentia Island with a cable which broke at the 300th mile, thus bringing the venture to an untimely end. Since that time all the difficulties of cable manufacture have been overcome. Cables can be laid with certainty and rapidity, so that the world has been gradually girdled with the slender cords which annihilate space, and we in London to-day are able to speak to Australia as surely and in less time than was needed 100 years ago to communicate with Oxford. From Valentia Island, Falmouth and Brest, a belt of ten cables traverses the Atlantic, and strikes the opposite shores at St. John's, Newfoundland, and at Sydney, Cape Canso, and Torbay, Nova Scotia. Thence land lines cross North America to San Francisco, and trend north through British Columbia to remote Alaska. From Falmouth again, through Lisbon, Madeira, and St. Vincent, two cables slant down across the Atlantic to Pernambuco, in Brazil, whence one coast line leads northwards to Para, at the southern mouth of the Amazon, while another, bending south to the mouth of the Parana, connects with the land line crossing the Argentine Republic and Chili to Valparaiso, thence communicating with another coasting cable girdling the eastern shores of the Pacific through Callao and Panama to Tehuantepec. From Panama, a line crosses the isthmus to Colon, and links with a cable which, passing north under the Caribbean Sea, unites at Kingston, Jamaica, with another line starting from Florida, and, running along the great chain of the West India Islands, ends at Georgetown, in British Guiana. Still another Atlantic cable leaves Lisbon and passes through the Canaries to Senegal. Eastwards from England, cables run down the Mediterranean from Gibraltar, Marseilles, Otranto, and Trieste, to Alexandria, where one branch leads north-east through Cyprus to Latakieh, and, connecting with overhead wires stretching down the valley of the Euphrates to the Persian Gulf, links with a cable landing ultimately at Kurrachee. Three cables pass down the Red Sea, of which one branches off from Aden through Zanzibar to Port Natal, thence communicating overland with the Cape; while the others continue their course to Bombay and couple up with land lines crossing Hindostan to Madras. From Madras a cable leads south-east through Penang, Singapore, and the eastern angle of Java to Port Darwin, linking to the long land line which bestrides Australia to Port Augusta, and thence communicates, *viâ* Melbourne, with Tasmania, and, *viâ* Sydney, with New Zealand. Branching off from this main line at Singapore, a cable leads to Saigon, and, passing up the China Sea to Hongkong, skirts the coast to Shanghai, and crosses the Yellow Sea to Nagasaki, ending at Vladivostock, where it joins the great Russian land line which completes the circuit back to Europe. Quite recently an independent line has been laid, coupling Hongkong with Port Hamilton, near the southern point of the Corean Peninsula.

This vast system, which places London within a few hours of Alaska, the Cape of Good Hope, New Zealand, and the Okhotsk Sea, has grown up for the most part on no principles except those dictated by trade requirements, is under no sort of international protection in war time, has no defined *status* in international law. Strategically speaking it is, from an English point of view, manifestly defective. The only communication with the important naval fortress of Hongkong passes through Saigon, a French station. All communication with Gibraltar and Malta traverses French, Spanish, or Portuguese territory. The important stations of Sierra Leone and St. Helena are at present inaccessible, while Mauritius lies isolated in the Indian Ocean and Bermuda in the Atlantic. Along the Suez Canal route to India, cable communication is very complete, but would be somewhat precarious in war time. The long sea route, however, the great alternative on which alone England can securely reckon, is without any communication with the exception of the unreliable line *viâ* Zanzibar to the Cape. The position of all the cable lines of the world is known with tolerable accuracy, and their destructibility varies practically with the depth of sea-bottom. It would probably be a long task to grapple for the North American lines in mid-ocean, considering that five weeks have been needed to find the line between Colon and Jamaica; but the shallow sea and the coasting lines would not be difficult to discover and to cut, while shore ends must, in many instances, be specially vulnerable. Thus, in a large number of cases, the possibility of preserving telegraph communication during war must depend mainly on naval activity. The Russians were reported to have made arrangements for cutting cables had war broken out this year, and it is evident that, if vessels specially equipped for the purpose can succeed in keeping the sea for any length of time, the amount of injury which could be effected would be very serious. Given speed, coal-endurance, and daring, this new method of damaging an enemy offers chances which are too well realised to be thrown away. The advantage of uninterrupted telegraph communication between a Minister of War and the headquarters of an army in the field is highly questionable, and a great general would probably find means to cut his cable upon occasion; but the strategic importance to England of maintaining telegraphic touch of her foreign stations can hardly be overrated. War ships are now dependent on the coaling stations, which give them the means of movement, and communication with these stations confers the power of naval concentration, and renders naval strategy possible in the higher sense, while it secures the timely warning which may mean safety. England has important stations which might be attacked in force long before the news of a declaration of war could reach them.

Broadly speaking, the danger to cables would be greatest at the outset of hostilities. As soon as England had definitely embarked on a great war and had more time to develope her naval strength and make her supremacy felt on the high seas, that danger would sensibly diminish. Cables can be repaired almost as easily as cut, since the main difficulty in either case is to find them. New lines can be rapidly laid. Ordinary foresight would, therefore, indicate that certain stations should always contain a large reserve of cable ready for emergencies, and that properly equipped laying and repairing ships should be available. The adoption of such an obvious measure of precaution might be taken for granted were it not that other vitally important measures have been openly neglected; while for years we have rested content with a scarecrow defence for the coaling stations on which the Empire may any day depend. It is doubtful to-day if half the members of the House of Commons could give their mere names, so superior are the fascinations of parochial matters to those of high imperial affairs. Complex and conflicting interests have grown up around the giant cable system of the world, some of which are worth noticing. Assuming that France, during a war with England, were to cut the Mediterranean or the Red Sea cables, she would deprive herself of all possible telegraphic touch with her Indo-Chinese possessions; since messages even if sent across Asiatic Russia to Vladivostock would be liable to interception at Hongkong before reaching Saigon. Moreover, to cut these cables would not deprive England of communication *viâ* Constantinople and the Persian land lines with India and thence with Singapore, Australia and New Zealand. England would have lost touch of the Cape, but could still speak to Aden *viâ* Bombay. On the other hand, since France could in no case feel assured of communication with Saigon and Tonquin—messages for either having to pass through Hongkong or Singapore—the supposed measure might not only recommend itself, but might perhaps be supplemented by an effort to cut the Persian Gulf line to Kurrachee, the Aden-Bombay, the Madras-Penang, and the Rangoon-Penang lines, the total effect of which would be to telegraphically isolate England from India and India from Penang and Singapore, with the incidental result of seriously interfering with Dutch interests in Java, Spanish interests in the Philippines, and possibly German interests at Zanzibar. Supposing, however, that it was open to England to communicate *viâ* Russia and Vladivostock, a further cable-cutting in the Yellow Sea or at Foochow and Amoy would be needed to isolate Hongkong. The North American cables might remain intact, since they deeply affect American interests, while they are relatively less vulnerable on account of their multiplicity and great depth. Again, to cut the West Indian cable would be to interrupt communication with the French islands; but, since all messages pass through Jamaica, France might elect to cut the line between Kingston and Santiago, Cuba, ignoring the interests of the owners of islands to the westwards, but would have further to cut the Colon-Kingston line to isolate Jamaica. England, on her part, might attempt to cut the Brest cables, thus concentrating all communication with North America at Falmouth and Valentia; while she would probably cut the Senegal line between the Canaries and St. Louis. The two cables from Marseilles to Algiers and from Marseilles to Bona might similarly be threatened by England, but the military advantages of cutting an enemy's communications diminish with their length and the operation would not be particularly valuable.

Russia could hope for little from cables in a war with England, and all her communications being interior land lines, she might elect to cut cables freely with the certainty of injuring English interests. While, however, she might seek to isolate Hongkong and the Australian colonies, she could not interfere with the lines west of Singapore without touching French interests in Cochin-China and Tonquin, while eventually German interests may come to be involved in the cable to Zanzibar. Thus, putting the North American lines out of consideration for the reasons above stated, it might be anticipated that Russia would seek to effect interruption north of Saigon, between Java and Port Darwin, and between Mozambique and Port Natal, with a view to isolate Hongkong, the Australian colonies and New Zealand, and the Cape respectively. Mediterranean communications would, perhaps, not be threatened, and even if an interruption of the Persian land lines could be arranged, touch with India would probably be maintained.

Spain might conceivably seek to sever England's touch with Gibraltar, Italy to isolate Malta, England retaliating by cutting the Otranto line to Alexandria; but in this case many other interests would be affected and considerable inconvenience would be inflicted on neutrals without any great military advantage being gained by either side.

Combinations of Powers might have been assumed, but enough has been said to show how involved are the interests concerned, and how conflicting the advantages to be reaped by cable-cutting. This alone will probably prove some safeguard to cables, and will at least serve to prevent mere random destruction. On the other hand, it is evident that of all Powers England has most to lose by the interruption of telegraph communication, while by retaliation she has little to gain. Thus far it has been assumed that the cutting of cables will play an important part in war, and that, as a weapon against England, it may be employed in spite of the commercial and other injury entailed upon neutrals. The whole question of cable-cutting is, however, one of which we as yet have no experience, and while it may be safely assumed that the rights, real and asserted, of weak neutrals will receive scant recognition, cases may occur in which the international aspects of cables cannot be lightly put aside.

International law is a vague term requiring much qualification. Great Powers agree formally that certain conditions shall be observed by them in war, or, by long observance, certain unformulated conditions win the sanctity of custom. This practically means merely that neither of two belligerents will go so far in contravention of this so-called law as to bring a powerful neutral into the field, and that neither is likely to commit any act which would bring upon it such a measure of moral opprobrium as might count as an adverse factor in its subsequent dealings with other nations. Weak Powers, unprovided with a strong backer, and semi-civilised Powers have reaped little benefit during war from international law in the past, and are unlikely to be able to calculate with certainty on its provisions in future. *Force majeure* can be advanced in justification of most questionable acts. When, in 1807, England suddenly seized the Danish fleet the act was probably indefensible under international law, while certain of the recent French proceedings at Foochow would tax the ingenuity of an advocate. While, however, international law has attempted to formulate regulations more or less definite with respect to such matters as contraband of war, submarine cables—either because their existence is too recent or because the questions relating to them are too complex and delicate—have not been brought within the scope of any understanding, formal or otherwise. It is true that the protection which an international agreement would promise could hardly be relied upon with any degree of certainty. Anchors might innocently foul important cables, and in weighing them it is only natural that the cables might be broken, just as no neutralisation of the Suez Canal will ever prevent vessels from accidentally sinking across it at critical periods. The grave inconvenience to neutrals which cable-cutting on a large scale would entail might, however, at least have led to an attempt to arrive at some sort of mutual understanding. It is worth while to consider a few of the questions which may any day present themselves. Despatches conveyed to a neutral by a belligerent are, of course, contraband of war. Are telegraph messages contraband, and may such messages, ocean borne, pass through a neutral station? Supposing France and Russia to be at war, can the Russians claim that no messages shall be sent over a British-owned cable to Saigon? It is clear that such messages might possess military importance, while to stop them would practically mean that no telegraph messages could pass from Singapore to Saigon.

Even then sham messages, ostensibly for Hongkong, might be read off at Saigon and might tell all that was needed. Have the Russians the right to cut the cable between Singapore and Hongkong? This would compel all messages from England for Hongkong to pass through Vladivostock, an arrangement for which England might not greatly care. England and France are at war. Despatches for Halifax and Jamaica are contraband. Has France the right—assuming that she has the power—to cut the Atlantic cables? To do so would be an almost intolerable nuisance to the United States, and would paralyse the business of New York. Again, how far does the ownership of cable lines affect the right to cut them, and could an American-owned line claim an immunity in this case which a British cable did not possess? France and the United States are the belligerents—are the British-owned cables liable to be cut on account of the value they would unquestionably possess for the United States? It might be argued that in mid-ocean they were the property of a neutral, but that within the territorial three miles of the American coast they were as destructible as a British-owned land line on belligerent soil. The above are only specimens of the class of questions which it is more easy to propound than to answer. Such questions may any day arise in the conflict of interests involved in cables in the capacity of transmitters of information of direct and indirect military importance, and in their civil capacity as international channels of communication by which the whole machinery of the vast commercial system of the world is moved.

Only last year the protection of cables in peace-time formed the subject of an international conference. A series of measures were agreed upon and now form a part of international law under which wilful or culpable damage to a cable is punishable in Consular Courts. It is remarkable that not only was no attempt made to exchange views on the far more important question of the position which cables are to occupy in war, but a clause was adopted which seems capable of being construed into an invitation to cut cables ruthlessly. By Article XV. it is provided that "the stipulations of the present Convention do not in any way restrict the freedom of action of belligerents." The Belgian representatives alone appear to have grasped the absurdity of this clause, and have placed on record their view that Article XV. is "absolument inutile aux yeux du Gouvernement Belge." Of all Powers England is most interested in securing the sanctity of cables. Having little to gain by cutting them, she has much to lose as a neutral and as a belligerent by having them cut by other people. Guileless of any special qualification for dealing with such a question, and, as usual in such cases, unprovided with naval or military advisers, the British representative adopted, if he did not frame, a clause which will at least serve to render future negociations more difficult. The clause is "absolutely useless," as the Belgians point out; this much will be generally conceded. The fact remains that the British Government, or its representative, was unable to see that anything which makes for the education of international opinion as to the neutralisation of cables makes for the interests of England, and was anxious to claim for her a freedom of action which, in default of all existing restrictions, no Power requires, and which she in particular does not really want. Of the 25 Governments represented at Paris some at least would probably have welcomed any proposal which tended towards the preservation of cable communications in war. If cable-cutting came into fashion and were elevated, or reduced, to a science, the position of neutral powers would be lamentable, and it is even conceivable that the first military Power of the age would have been found willing to further the cause of civilisation by any measure directed towards the neutralisation of cables. It is useless to blind ourselves to possibilities we may have to face, and a cool consideration of these possibilities can do no harm. England being neutral, the seizure of a British ship by a belligerent would, under certain circumstances, constitute an act of war. The actual injury inflicted would be the merest trifle in comparison with that entailed by the cutting of certain cables. Is it permissible under any circumstances for a belligerent to cut those cables; or is England prepared to make the cutting of them a *casus belli* and to proclaim her intention in advance? On this point it is as well that we should make up our minds.

LEGAL.

The Provincial (Brush) Electric Light and Power Company, Limited, v. Shillingford and Bateman.—This action was tried before Mr. Justice Field, sitting without a jury, on Thursday and Friday last week, in the Queen's Bench Division of the High Court. The plaintiffs sued the defendants, who are a firm of brewers in Whitney, Oxfordshire, for £53 odd, which they alleged was due to them as the balance of their account, in respect of an electric lighting installation at the defendants' brewery. The defendants, who had already paid the plaintiffs £100 in respect of the installation, resisted the payment of the balance claimed on the ground that the plaintiffs had guaranteed that the installation should be a success, which they alleged had not been the case, for that after a trial of three or four months it had entirely failed, and they were obliged to give it up and return to gas as a luminant. It was further alleged that £50 of the £100 already paid was sufficient to satisfy any claim which the plaintiffs had against the defendants. The defendants further counter-claimed to have the remaining £50 returned to them by the plaintiffs, on the ground that it was money paid under a mistake of fact, viz., under the belief that the electric light would be a success. The defendants also claimed £50 damages for being deprived of the advantages of the installation. The plaintiffs admitted the guarantee, and also that the installation ultimately failed, but contended that such failure was brought about by the fault of the defendants themselves, and after they (the plaintiffs) had ceased to control or conduct the working of the electrical plant. They had, it was argued, fulfilled their contract within their guarantee as soon as they had completed the installation and handed it over to the defendants as a thoroughly satisfactory and working concern. As the learned judge remarked, the question raised was a curious and novel one, and those interested in electric lighting will await his lordship's decision with some interest. It appeared that the defendants, in 1884, got into correspondence with the plaintiff company, who had carried out the electric installation at Colchester, with a view of adopting the electric light at their brewery. On July 29th Geo. Offor, jun., sub-manager to the plaintiffs, was sent down to look over the brewery and discuss the project of lighting. There was a 3¼ horse-power steam engine on the premises, and ultimately, after some further correspondence between the parties, it was agreed that the plaintiffs should install the brewery by using the defendants' engine to work their own system of secondary batteries. Ten to twenty of the company's incandescent lamps, of about 50 candle-power, and said to average a life of 1,000 hours, were to be used. The plaintiffs also guaranteed that it would be a success if it were put up by them and under their supervision. Mr. Thompson, assistant electrician to the company in September, 1884, effected the installation, which, after a successful trial of a few days, was, at the request of the defendants, handed over to George Baker, an engineer who had been in their (defendants') service some ten years, but who knew nothing more of the science of electric lighting than what he might have gathered while under the directions of Mr. Thompson during the probationary period of the installation. Definite instructions were left with Baker as to the mode of carrying on the electric lighting, and it was suggested by the plaintiffs that these he had neglected; he, however, positively swore he had invariably adhered to them. During this period, viz., from October 1st to October 16th, a constant correspondence appeared to have passed between the defendants and the plaintiffs, chiefly about small corrections, or alterations, necessary in certain details connected with the installation, but no actual complaint of non-success appeared to have then been made. On October 16th, the defendants wrote the plaintiffs in effect that the light answered fairly well, but four days afterwards they complained that it was not so good as when started. From the correspondence, the chief difficulty appeared to have been with regard to the lamps and the accumulators, the filaments of the former constantly breaking. This the plaintiffs attributed to over-running. The lamps produced were carbonised or discoloured, a fact which, the evidence seemed to indicate, favoured such a charge. On November 3rd, the plaintiffs sent in their account, amounting to £145 13s., and on November 10th the defendants replied that they would send a cheque as soon as the working of the light satisfied them. On December 12th the plaintiffs' sub-manager went down about the account, and on December 16th the defendants sent the plaintiffs a cheque for £100. On February 6th the dynamo was sent back to be repaired, and soon after this date the defendants appeared to have given up the electric light altogether; and they declining to pay any further sum to the plaintiffs the present action has resulted. The defendants' particulars of complaints were:—1st. Cells of accumulators insufficient for holding acid and consequent leakage. 2nd. Brushes wearing out. 3rd. Filaments bad. 4th. Insufficient connections between the different lamps. 5th. The life of the lamps too short. 6th. Fuses and automatic cut-outs carelessly adjusted so that the batteries were not under proper control. 7th. Insufficient accumulators.

Alexander Thompson, assistant electrician to the plaintiffs, was called, and stated that he put up the electrical plant at the defendants' brewery and went down again once afterwards to inspect it. He replaced the earthenware jars (in the batteries) with others. He did so not because they were of imperfect construction but because similar ones had given way in other places. The first ones would not hold the acid. The brushes were copper. The dynamo converted energy into electricity which was led off by copper wires to the battery composed of earthenware jars in boxes, and so the electricity was stored. Further wires led the electricity from the batteries to the lamps. The engine was, he said, capable of charging the accumulators. He had given Baker—the defendants' engineer—full instructions how to act. The accumulators would light the lamps for four or five hours. It would occupy six hours to recharge the accumulators when depleted. The lamps could not safely be illumined whilst the engine was running and charging accumulators. Leakage from the cells would diminish the duration of the lights. The accumulators ought to have some protection against over charging or the accumulators would wear out, by oxidising the plates and causing them to buckle. He had laid the installation down on the storage system so that all the current would run through the accumulators. It was completed by the end of September, and the filaments and brushes ought not to have worn away by October 20th; the former should last about 1,000 hours, and the latter three or four months. He had shown Baker how to adjust the brushes, which should be readjusted every time the batteries were recharged. Too much pressure would wear out the brushes. In his opinion the cause of the filaments breaking was that too strong a current had been used, or by running the lamps at the same time as the engine was charging the accumulators. This witness stated that Baker or some one had told him that he had done this, but Baker, when called, denied it. The dynamos used were those of Elwell and Parker. The filaments of the lamps which he brought back were blackened and carbonised. This indicated that too strong a current had been used.

Mr. Frank King, acting engineer to the company, stated that he had gone down to the brewery on October 1st, had found the dynamos and all the plant fixed, and he then commenced to charge the storage batteries. He had taken the speed of the engine and the current rendered by the dynamo (*i.e.*, the volume irrespective of the pressure). The pressure was called E.M.F., and depended upon the speed of the engine. Too much current would pass into the batteries by excessive pressure, and so destroy the dynamo. He found the dynamo perfectly satisfactory. The brushes and commutators were the most sensitive part of a dynamo, and those used were excellent. The brushes should be looked to every hour, and would last for six months. The accumulators did rest upon iron rods, but that did not cause any leakage, as suggested, because the jars were of stoneware. Had the filaments broken because of faulty construction, there would have been no discolouration of the glass. Tinfoil fuses were used as a safeguard, in case too strong a current should be allowed to pass along the wires; in such a case they would melt, fall out and so cut the circuit at once. He had told Baker to drive his engine according to the current indications. Witness explained the ammeter to him, and directed him to never allow the needle to indicate more than 25 ampères. He had seen the dynamo when sent back to them for repair, and the armature coils were all damaged, in his opinion, from ill usage.

Mr. Offor, sub-manager to the company, said that when he had gone down about the account on December 16th, Mr. Bateman, the defendants' manager, had said that the installation was not working well. He (Offor) had made no complaints regarding Baker's management and had asked to see him.

That closed the plaintiffs' case, and George Baker was called for the defence. He said he had been 10 years an engineer in the defendants' service. His evidence was in substance that though he did not understand electricity, yet he had strictly followed and carried out the directions he had received from Thompson and King. He charged the batteries every day between 9 a.m. and 5 p.m., winter and summer. He also stated that the plaintiffs' Mr. Lovel came down three times, and upon the last occasion he had said, "I am sick of coming down here; they know it won't do what they promised it would; you cannot get blood out of a post." Thompson had showed him how to make fuses out of the tin foil, and how to fix them in their places. He never lit the lamps in the daytime. There were about twenty lights in all. The charge never lasted more than three or four hours.

Mr. Coles, the defendants' brewer and manager, said he was daily at the brewery, and at times in the night as well. The electric light lasted according to the number of lamps used at a time. With only five lamps, it lasted about five hours; if more were in use, not four hours. They were nearly always, he said, left with a failing light in the evening, and he had to supplement the light by gas at 9 o'clock, he might say a dozen times. The light ran from the end of September, 1884, until the end of February following. He had had occasion ever since the commencement of the installation to burn gas at 6 a.m., when brewing. There might have been constant light from four lamps during the night, but never enough for brewing at 6 a.m. His complaints were based on his own personal knowledge, and not from hearsay. Though the electric light was new to him, he had some idea of it. In cross-examination he said: On October 16th the light was satisfactory, and at that time eight lamps were burning well. They would have been quite contented with ten good lights. When he lit the office lamps he used to have to cut off some of the others. They had given up the light about March, 1885. The defence also called an expert to contradict some of the scientific evidence upon which the plaintiffs relied, and also to show how leakage of acid must have arisen by the force of capillary attraction owing to the position and manner in which the plaintiffs had placed their accumulators; but the learned judge declined to go into those matters, and Mr. Rose summed the case up for the defendants, contending that the light had never been a success from first to last, and so the plaintiffs had never fulfilled their guarantee.

Mr. Cunninghame, for the plaintiffs, replied, submitting that his clients had done all required of them when they had handed the installation over complete and working well. He contended that the facts of the filaments, when breaking, discoloured the glass, the sparking and wear of the brushes, and the constant melting of the safety fuses, all spoke for themselves, and pointed incontestably to neglect and mismanagement by over-running the engine, or in some other way permitting too strong a current to pass along the lead wires. It was admitted the dynamo was a good one, and that all went well for a week, when the plaintiffs ceased control. This, he contended, was a success within the intent of the contracting parties. He also referred to the fact of the defendants having sent his clients £100 after the letter in which they stated that they would pay the account when the light was satisfactory, and argued this was in effect an admission by the defendants of the plaintiffs' success.

Mr. Justice Field, at the close of the case, said the substantial question which he had to determine, was whether or not the existing facts showed the installation to have been a success. It was a novel point, and, therefore, he would take time to carefully consider the whole matter, from a common sense view of all the surrounding circumstances, and would discard all the intricate and perplexing scientific evidence, the inferences from which, to his mind, were so conflicting, ambiguous, and misleading. He was not an electrician, and could not deal with or weigh the effect of such nice scientific distinctions. If, his lordship remarked, either counsel desired to press it, he would, of course, go into it, but he gathered from the conduct of the case that both parties were willing that he should deal with the subject as he had suggested.

His lordship's decision will probably be given in time for our next number.

NOTES.

The Electric Light in the Royal Navy.—The new steam cruiser *Thames*, which has been launched at Pembroke, is to be fitted with two electric search lights. The total cost of the vessel will reach £153,500, and after she has been prepared for sea she will be taken to Devonport to receive her armament.

It is satisfactory to note that the Admiralty have instructed the dockyard officers at Portsmouth to report as to their opinion on the present method of dealing with the internal electric lighting of ships in the Royal Navy. They are desired to state whether they consider that the contracts for the installation of the electric light into Her Majesty's vessels should continue to be given to private firms, or whether, on the other hand, it is desirable that all such work should be carried out by dockyard employés. If it is their opinion that the work should be done in the dockyards, they are to state what staff of officers and artificers will be required for the work. It is considered unlikely that the dockyard officers will reply that they are unable to carry out the work, and therefore there is every reasonable prospect of the work being in future entirely carried out at the various naval establishments. This would, of course, be a rather severe blow to private enterprise, but it is felt that the service would gain by the change, inasmuch as the Admiralty might not hesitate in employing their own men to instal the electric light on a ship, whereas they might have some scruples in inviting tenders.

Theatre Lighting.—We believe that Covent Garden Theatre will still be illuminated by means of the Jablochkoff system during the forthcoming circus season. We congratulate Mr. R. Newington on the success which has hitherto attended his work at this popular place of entertainment.

Electric Lighting in the United States.—The New York *Electrical World* makes the following comments on the articles on "Electric Lighting in the United States," recently written for this journal by Mr. Charles Lever:—"We must again refer to the criticisms on our electric light systems which a recent English visitor makes. They are evidently the impressions of an intelligent foreigner, who has perhaps not spent sufficient time among us to appreciate our peculiar institutions. Some of his suggestions will bear study, and it would be interesting to know why English arc lamps show up better than our own—if they do. Again, Mr. Lever seems to think that our high-tension arc systems are temporary, and questions whether the supply of thousands of arc lights to stores, &c., for advertising purposes, is a healthy development of the electric light. If statistics can be depended upon, this statement is uncalled for, since the arc light is steadily advancing and, although it is used in some cases for advertising purposes outside of buildings, its main increase is in the interior, where absolutely more light is required than had heretofore been available. Mr. Lever does not take kindly to the system of running incandescent lamps on arc circuits, and hopes it will not be extended. This wish is rather unkind, as the system has its *raison d'être* as well as any other, and the objection only arises from Mr. Lever's animosity to high tension currents, the spread of which he bewails. We also fail to see why better results should be obtained by placing the electric lighting in the hands of municipal authorities, which, Mr. Lever thinks, will eventually occur. However, the genial critic pays us a compliment in averring that our incandescent lamp holders and fittings are superior to those of his own country, and this goes to prove that his criticisms are sincere, if not always deserved."

Electric Lighting at Dalton.—The Local Board of Dalton has resolved upon lighting a portion of the town by the electric light, and Prof. Jamieson has been to the town to inspect and report on the best means of lighting Askam, Ireleth and the Lots. According to the surveyor's report, which was adopted by the board, either a Mr. Massicks or a Mr. Menzies (it is not clear which) offered to light two arc lamps on Lots for the sum of 9d. per hour per lamp, the contractor to find everything after the posts and lamps are once erected in good order by the board.

Electric Lighting in New York.—The contract for a new 10-light dynamo and other necessary additions to the electric light plant of the East River Bridge, New York, has been awarded to the United States Electric Lighting Company at the price, $1,325. The Brooklyn Electric Construction Company was the lowest bidder at $1,250, but the contract was awarded on the recommendation of the chief engineer.

Paper on "Electric Lighting."—Mr. A. Grundy, under whose charge the electric lighting installation at the New Law Courts was for some time placed, recently read a paper before the members of the Clerks of Works Association on "Electric Lighting." Mr. Grundy dealt with the subject in a manner exactly suited to the character of his audience.

Electric Lighting at Blackpool.—The Highways Committee of the Blackpool Town Council has recommended that the Promenade be lighted by the electric light on the 24th inst. and the 10 following days, and it has been decided to adopt the recommendation.

The Meucci Telephone Claims.—The claims of Antonio Meucci to priority in the invention of the telephone are now being investigated in New York by Secretary Lamar. This inventor's instruments were fully described by us in our articles on the Philadelphia Exhibition last year, and similar descriptions are now appearing in the New York papers. Speaking on this subject the New York *Electrical World* says:—"Our article on another page detailing the claims of Antonio Meucci to the invention of the telephone, might almost be said to read like a painful romance. It seems well-nigh impossible that a finished invention, such as Meucci claims to have had as far back as 1864, should have remained in obscurity in spite of the strenuous efforts of the inventor to bring it before the public. Yet if we are to believe Mr. Meucci, such is the case. Meucci's claims, it must be admitted, bear the stamp of genuineness, in that his instruments show a series of stages of development, such as every invention passes through before reaching perfection, and the witnesses he cites in his affidavit filed in the case before Secretary Lamar, at Washington, would appear to substantiate the fact that he transmitted speech as he declares. It must be looked upon as another evidence of the fickleness of fortune that Mr. Grant was prevented from making the test on the District Telegraph lines in this city, for, if tried, the success or failure of Meucci's instrument would have been demonstrated. Still the question arises, why did not Meucci apply to other owners of lines, and the only answer he gives is his lack of knowledge of the English language, and his great poverty, which compelled him to stick to his work to gain a livelihood. Meucci's story, if true, is another example of the hardships experienced by pioneers in any line, and of mishaps, which will continue to be chronicled as long as there are inventors on earth."

The Telephone at Bournemouth.—The Western Counties and South Wales Telephone Company has submitted a scheme for overhead wires for a telephone exchange in Bournemouth to the Improvement Commissioners of that town, who instructed their clerk to obtain information from Bristol and Torquay, where similar exchanges have been established.

Private Telephone Lines.—The Oxford Local Board has declined to grant permission to Colonel Whigham to carry a telephone wire overhead from his house in St. Margaret's Road to the house of his adjutant in Warnborough Road.

Telephone Poles.—The directors of the Lancashire and Cheshire Telephonic Exchange Company desire tenders for the supply of larch and creosoted poles during the year ending December 31st, 1886, to be sent to 38, Faulkner Street, Manchester.

The United Telephone Company's Patents.—Mr. Justice Kay last week granted an injunction prohibiting Mr. A. F. St. George from manufacturing, selling, supplying, or otherwise dealing with certain carbon telephone transmitters, said to be within the Edison patents, held by the United Telephone Company, pending the hearing of an action against him for infringement.

Telegraphists from the Cape.—The hired transport *Poonah* was expected to arrive at Portsmouth on the 9th inst. from the Cape of Good Hope, with the telegraph section of the Royal Engineers, time-expired men, and invalids.

Submarine Cables in Warfare.—The *Times* article which we republish in our columns to-day, only sustains what we have already written on this subject, viz., that the true security of telegraphic communication lies in having the cable systems touch at as many points belonging to different nations as is possible. Lines from English colony to English colony are weak in so far that should we be engaged in war our enemies would not hesitate to cut our lines, there being no neutral power interested; but, should our cables run from an English colony to a neutral port we are safe, although the truest safety lies in trusting our communications through cables beginning in a neutral port and ending in a neutral port. For these reasons, which are self-evident, the policy of the Eastern and Eastern Extension Companies has been a wrong one, as they, with the exception of Lisbon and Egypt—the stations on the route to the East—are on English territory. To render our communications perfectly secure with the East a cable should be laid from San Francisco to Japan or China.

On Radiation of Heat from the Same Surface at Different Temperatures.—Mr. J. T. Bottomley has written to *Nature* with respect to his recent communication on the subject of radiation of heat at different temperatures, saying:—"I wish to remark that the temperature given as the temperature of the surroundings must be taken as only approximate. A remark to this effect was in fact included in the first draft of my note to you, and was inadvertently omitted in the final copy. If the glass envelope surrounding the wire were perfectly diathermanous, and likewise the intervening air, then the temperature of the surroundings would be simply that of the walls of the room. As it was there is a great difficulty in saying precisely what is to be taken as the temperature of the surroundings. The glass envelope becomes heated to some extent, and will return a certain amount of radiation to the wire. When the vacuum is nearly complete, however, the heating of the glass is slight, and is very small in comparison with the heating when the vacuum is only partial. The reason I have not used a metallic envelope blackened inside and cooled outside, is that it is very difficult to attach such an envelope in a satisfactory way to the Sprengel pump. I am, however, hopeful of being able to overcome this difficulty."

Vicissitudes of an Old Cable Ship.—A charge of fraud against the directors of the Great Eastern Steamship Company and a member of a firm of ship-brokers of Milford Haven is pending at the Mansion House police court, having reference to an alleged conspiracy to defraud the Great Eastern Syndicate Company.

Engines at the Cattle Show.—Prominent among the exhibits of engines and machinery at the Islington show this week were some very fine specimens of the compound and other engines from the works at Lincoln, of Messrs. Ruston, Proctor and Co., especially an improved compound semifixed engine of 10 horse-power nominal of their new type. Its two cylinders are 6½in. and 10in. diameter respectively. Steam of 120 lbs. pressure is used, which is admitted first into the smaller cylinder and expanded to twice its original volume, and then passing to the larger cylinder is again expanded, escaping into the air with a final pressure of under 10 lbs., or less than in an ordinary engine. By this system the full available work is obtained from the steam, which, combined with carefully worked out proportions and excellent workmanship, has enabled such an economy in fuel to be realised, as hitherto has only been possible with costly condensing engines. In a trial of a 12 horse-power compound portable engine with a load of 30·26 horse-power on the brake it ran for 3 hours and 45½ minutes, with only 300 lbs. of Welsh coal, equivalent to the extraordinarily low consumption of 2·63 lbs. per effective horse-power per hour, or about 2·4 lbs. per indicated horse-hower; whilst the feed-water required was only 20·46 lbs. per E.H.P. per hour. At least 50 per cent. more would be required by an ordinary portable engine.

City and Guilds of London Institute.—At the quarterly meeting of the council last week the Earl of Selborne, chairman of the council, made an earnest appeal to the City and Livery Companies of London to subscribe the necessary funds to complete the work of organising a national system of technical education, on the success of which the commercial prosperity of the country so greatly depended. He referred to the large amounts of money which the companies had already contributed, but at the same time he compared the smallness of the whole sum asked for by the institute with the total corporate income of the companies, and pointed out that by liberally subscribing the funds now needed the City Guilds would deserve, and he hoped obtain, the permanent gratitude of the nation.

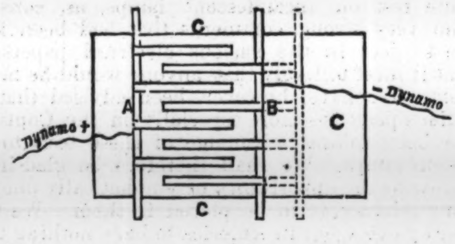
The Franklin Institute.—The Franklin Institute has just elected six new honorary members, a distinction which is rarely bestowed. The recipients of this honour are: Louis Duncan, Ph.D., Ensign U.S. Navy; Prof. William D. Marks, University of Pennsylvania; Geo. L. Anderson, Lieutenant U.S. Army; J. B. Murdoch, Lieutenant U.S. Navy; A. B. Wyckoff, Lieutenant U.S. Navy; and George M. Ward, M.D. These names will be recognised as belonging to the gentlemen composing the committee which carried out the recent tests of lamps and dynamos for the Franklin Institute.

Electric Launches.—In June last Mr. Reckenzaun had the privilege of taking the Duke of Bedford, accompanied by Lord Sudeley, for a cruise in the electric launch *Australia*, the duke's magnificent steam yacht *Northumbria* being at the time anchored off Gravesend. His Grace was so pleased with the performance of the *Australia* that he decided to order a boat of similar design but of more elegant appearance, and the Electrical Power Storage Company was entrusted with the construction of the propelling apparatus of this new vessel, which is some 3 feet longer than the *Australia*; the internal arrangements, however, are very similar. Twenty-nine E. P. S. accumulators are placed in a box in the centre of the boat, this box serving as a seat for passengers; the cells actuate a "Reckenzaun" motor, and the speed obtained is of the average rate of six knots per hour for 4½ hours. The accumulators of this boat serve also for lighting the yacht when the electric launch is suspended from the davits, and the cells are charged from the dynamo which usually lights the *Northumbria*. The official trial took place on Wednesday last week, at Westminster, in the presence of numerous spectators. We learn that Mr. Reckenzaun has at this moment several designs of electric boats in progress which will embody further substantial improvements. One of these is being executed to the order of the Italian Government, and a second for an Indian prince; the former is for war purposes and the latter for pleasure. The prince's launch is to be fitted most luxuriously, and electrically lighted, even the fans being actuated by electricity.

Festivities of Telegraphists.—The annual dinner of the Leeds Postal Telegraph staff was held in the Grand Restaurant, Boar Lane, on Saturday evening last, Mr. Seal, postmaster, in the chair. After the usual loyal and patriotic toasts had been given, the toast of the evening—"The telegraph brotherhood at home and abroad," was proposed by Mr. Bosomworth. Mr. Trenam, superintendent of the commercial branch, in reply, referred to the recent introduction of the sixpenny rate, and gave it as his opinion that, notwithstanding the large sum of money that had been spent in preparing for the cheaper telegram, there was every reason to believe that in a very short time the increase in the telegraph revenue would justify the change that had been made.

New Electrical Firm.—Messrs. Baily and Grundy announce that they have commenced business at Amberley Works, Amberley Road, Paddington, as electrical and general engineers.

Liquid Resistances.—In the last number of our esteemed contemporary, *L'Electricien*, M. P. Juppont writes in an enthusiastic vein respecting a rheostat devised by M. Cance for operation in connection with the electric lighting of the Eldorado Theatre. A bath is filled with a solution of salt and water or dilute sulphuric acid, and in this are suspended plates of zinc forming a series, alternately connected with the poles of the dynamo. By moving one series of plates, the other remaining fixed, a greater or less resistance may be introduced into the circuit as desired. In the sketch appended A is the fixed series of plates, B movable plates, and C the bath. M. Juppont evidently imagines that M. Cance has been the first to apply a liquid resistance to the regulation of lamps in theatres, but, as our readers are aware, Mr. Littleton has for some time past used most successfully a similar apparatus in connection with the lighting of his small private theatre at Sydenham.



Bradford New Post Office.—The new post office at Bradford, which has been the subject of repeated agitations extending over a number of years, is now in course of erection. The building is to stand on a site near the new Midland Station, which was purchased by the Government for £37,650. Ample accommodation is being provided for both postal and telegraph departments, so that the inconvenience of having these branches in different parts of the town, as at present, will be done away with. The ground floor is to be devoted to public offices and postal accommodation, while the first floor will be entirely occupied by the telegraph department. The instrument room, which will be in the front of the building, is to be 88 feet by 30 feet, and a telephone room 33 feet by 22 feet will adjoin it. Besides retiring rooms, offices will be provided on this floor also for the superintendent of the instrument room, and for the engineering inspector of the district. The second floor will be chiefly taken up by the battery room and workshops of the linemen and mechanics. The building is expected to be completed during next year.

Elieson's Electric Tramcar System.—An article on this subject, in which more enthusiasm than good judgment was shown by the writer thereof, appeared in an esteemed contemporary a few weeks since. A correspondent, signing himself H. S. (these initials, by the way, forcibly reminding one of the inventor of a rival scheme), has in a very able manner called in question the accuracy of the statements made, and ends his letter by expressing an opinion to the effect that the system to which we refer is a retrograde movement in electric tramcar propulsion. We have already made known our own views respecting Mr. Elieson's invention, and, although we are inclined to agree with H. S. in the main, we still believe that the Electric Locomotive and Power Company can run the cars of the North Metropolitan Tramway at a cheaper rate than is the case by the employment of horses.

Dynamo Tests.—The remarks of Mr. E. Weston which we publish respecting the dynamo tests given in our issues of November the 21st and 28th, will commend themselves to the notice of our readers.

Expensive Lighting by Gas.—At the last meeting of the Hastings Town Council, the Lighting Committee recommended the adoption of the new contract with the gas company for the lighting of the public lamps at £4 5s. 6d. per lamp per annum. Mr. Councillor Revill explained that the new contract was an increase of 4s. a lamp per annum, which meant a difference of about £180 a year. He thought the gas company would have conceded something. Mr. Alderman Winter expressed the opinion that as the council spent £4,000 a year upon public lighting, they were entitled to a little more consideration. It was a mean and discreditable act. The report was adopted.

International Inventions Exhibition. — Messrs. Walter Barker and Son have executed the engravings represented here, illustrative of the medals awarded in connection with the Inventions Exhibition.

The West London Provisional Orders.—Application is intended to be made to Parliament in the ensuing session for leave to bring in a Bill to extend the time limited by the Electric Lighting Act, 1882, or by the St. James's, St. Martin's, and St. George's, Hanover Square (West London) Electric Lighting Order, 1884, and the Electric Lighting Order Confirmation (No. 3) Act, 1884, within which any local authority might require the West London Electric Lighting Company, Limited, to sell their undertaking. Power will be sought for to extend the time within which the local authority might, under the provisions of the Order, serve a notice on the company requiring them to apply to the Board of Trade to direct that any part or parts of the area included in Schedule B should be added to the area included in Schedule A respectively annexed to the order, and also to extend the time within which the local authority, on the failure of the company to apply to the Board of Trade, pursuant to such notice, might apply to that Board to remove such part or parts from the operations of the Order. The Bill will contain clauses extending the time within which the company are or might be required by the Order to lay down distributing mains for the purposes of general supply as defined in the Order, excepting the company from any penalty with reference thereto, and with reference to any of the provisions of the order relating to compulsory works or otherwise; enacting that the provisions of section 27 of the Electric Lighting Act, 1882, shall not apply to the company, and prescribing the terms and conditions upon which any sale or purchase of their undertaking, or any part of it, might be required or made. The Chelsea Electricity Supply Company, Limited, notifies its intention of applying to the Board of Trade, on or before the 21st prox., for a Provisional Order authorising the company to produce, store, and supply electricity within the parish of Chelsea, to construct works, lay down wires and other apparatus, and to break up streets therein; and to levy rates, rents, and charges for the supply of electricity and the use of any machines, lamps, &c.

Overhead Telephone Wires at Bath.—Mr. H. F. Lewis, manager of the Western Counties and South Wales Telephone Company, asked permission of the Bath Town Council to run overhead wires through the city to connect Bath with Bristol. The question came before the surveying committee at a recent meeting, when Alderman Wilkinson moved a resolution that the application be granted so far as the authority had power to allow overhead wires across the streets within the district; any application to erect posts to be applied for separately and to be considered on its merits. Mr. Cox seconded. Mr. R. O. Heywood thought it would be of benefit to the Corporation, which should take an interest in it. Mr. Oliver raised the question of the power of the committee with regard to the matter. Alderman Bright moved an amendment that the subject be postponed for a fortnight before they allowed a mighty cobweb to be spread over the city. Mr. Collins seconded. The voting was five for and five against, and the chairman gave a casting vote in favour of the amendment.

A Standard of Light.—Upon this subject, respecting which, information will be found in our last week's columns, the *Electrical World* writes:—"It seems strange that the construction of a standard electric lamp should have been so long delayed; but now that we have one it would be well to point out that for prolonged accuracy it must, like other secondary standards be compared with the original from time to time. The Edison instrument is evidently accurate only as long as the resistance of the lamp remains constant. Any change in this respect will cause change in illuminating power. Hence where accuracy is required the lamp ought to be compared with a standard candle occasionally. The use of the electric lamp, however, is so convenient that it will easily supersede other methods in which constant corrections are required."

Electric Lighting in the Navy.—The Admiralty has solicited the opinion of the dockyard officers at Portsmouth, as the result of the experience of the yard with respect to the best method of dealing with the internal electric lighting of Her Majesty's ships. They are desired to state in their report whether it is preferred to continue the present system of placing the work in the hands of contractors, or to arrange in future for the performance of all the electrical work in ships by the dockyard *employés*, making separate contracts for all the material that may be required, in which should be embodied the proper conditions for testing before receiving the several items. The officers are also required to state what number of workmen and leading men is considered to be a proper staff for the Portsmouth yard, and what number of assistant constructors for electrical fittings they think can be usefully employed at Portsmouth and at each of the other yards.

Davey Safety Motor.—On Tuesday evening last, on the occasion of the annual conversazione of the Leeds Philosophical and Literary Society, which is always a brilliant assembly of the representatives of the science, art, and literary societies of the town and of the leading families in the district, Mr. Wilson Hartnell illuminated the library with three groups of six incandescent lamps arranged round the edge of Japanese parasols, which covered the gas fittings. The lamps were of 20 C.P., and were fed from a Crompton dynamo, worked by one of the Davey motors which were at the Inventions Exhibition. This engine, after this temporary use, is destined for permanent fixture at Mr. Davey's private residence. Another of the same size (4 H.P.) has just been sent to Mr. Bumsted, of Hednesford, who intends using it for lighting his house; and as it requires no skilled attention, and costs very little for fuel, it has a considerable advantage over a gas engine.

"A New Telephonic Enterprise."—The *Daily News* recently asserted that there was talk of a scheme by which lines would be conducted from opera and theatre to a large public hall, where passers-by might step in and hear what was going on at Covent Garden, or elsewhere, by telephone. Mr. A. R. Bennett, of the National Telephone Company, has written that this scheme has been an accomplished fact in Scotland for at least two years. Subscribers to his company's Dundee, Broughty Ferry, Newport, Perth, Forfar, and Arbroath exchanges are, on demand, switched on to the Dundee Theatre Royal, while a performance is proceeding, and by means of transmitters fixed near the orchestra, are enabled to hear the music, dialogue, applause, &c., in their own offices or homes: and the privilege is frequently taken advantage of. The public may enjoy the same facility at any of the company's call offices by payment of a small fee.

Incandescent Lamp Tests.—Messrs. Woodhouse and Rawson write:—"It was not our intention to take any notice of the published results of the Franklin Institute test on incandescent lamps, as, considering the very strong comments that had been made on the subject in the various electrical papers, we thought it most unlikely that anyone would be misled by them. We have, however, been advised that unscrupulous persons—more especially on the Continent—have been taking advantage of these tests to disparage our lamps. We shall, therefore, be glad if you will allow us the opportunity of emphatically denying that any reliance is to be placed in them. We were advised by our agent in America to have nothing to do with the tests, as they would not be reliable—the Swan, Maxim, and other makers of incandescent lamps having refused to allow their lamps to be entered. Lamps, however, stated to be ours were entered without our knowledge or consent, half being actually supplied by the Edison Company, the chief competitors, and the rest being obtained from another electric lighting firm. Whilst being admittedly run at 5 volts above what they were labelled, giving out up to 40 per cent. or 50 per cent. above the proper candle-power, they were placed in competition with lamps evidently most carefully made and tested beforehand. As an example of the way in which the electrical press have treated the tests, we may call attention to the *Electrical Review* of America, dated June 13th, in which are given *verbatim* reports of interviews with the President and Secretary of the Institute; the latter stating that he refused to have anything to do with the incandescent lamp tests because he did not believe in them. Another official of the Institute stated some three months ago that it was very doubtful if the tests could be seen by outsiders, as the tests themselves did not agree. Whilst in many instances disagreeing with the methods adopted in the actual tests, we refrain from criticising them, as we are well aware of the many difficulties that have to be contended with. We merely add that we think that the Institute ought to have seen that we were properly protected and advised of what was going on. We are glad to hear that there is some chance of complete tests being made in this country, when every precaution will be taken to ensure these being properly made."

NEW COMPANIES REGISTERED.

Coates, Macdonald & Co., Limited.—Capital £15,000 in £5 shares. Registered office, 60, Queen Victoria Street. Objects:—To take over the business of wholesale and retail dealers in electric, photographic, and other scientific apparatus, carried on by Herbert John Coates and Edward Wm. Johnstone Macdonald, at Arnold Works, Bow. Signatories:—H. J. Coates (electrician), 6, Laurence Road, Bow, one share; E. Macdonald (electrician), 15, Landseer Road, Bow, one share; G. B. Paul, 21, Billiter Street, one share; A. P. Friend, 48, St. George's Road, S.W., two shares; G. M. Sale, 195, Aldersgate Street, one share; J. A. Macdonald, Rhyl, two shares; James Boyd, 7, Nicholas Street, Manchester, two shares. The number of directors is to be five. While holding shares in this company, the Electric Apparatus Company, Limited, are empowered to appoint three of the directors. Registered 3rd inst., by Messrs. Marsland, Hewitt and Everett, of 124, Chancery Lane.

Automatic Checking Apparatus Company, Limited.—Capital £12,000 in £1 shares. Registered office, 47, Cannon Street. Objects :—To manufacture apparatus for checking fares, &c., and generally to carry on the business of mechanical and electrical engineers and machinists. Signatories :—G. R. Burn, 6, Bell Yard, Doctor's Commons, Percival Everitt, 47, Cannon Street, 100 shares each ; R. W. Burn, 353, Brixton Road : A. T. Frampton, East Molesey, Surrey ; T. W. Vallis, South Ealing ; E. Hore, 49, Queen Victoria Street, one share each. Directing qualification, 100 shares. Registered 5th inst., by Messrs. Adam Burn & Son, 6 Bell Yard, Doctor's Commons.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES

Anglo-American Brush Electric Light Corporation, Limited.—Under an agreement of 27th ult., and filed on the 1st inst., this company will allot fully-paid shares to certain shareholders of the Great Western Electric Light Company, Limited, and the Brush Midland Electric Light Company, Limited, in pursuance of agreements dated 28th and 29th of November, 1884.

CITY NOTES, REPORTS, MEETINGS, &c.

Blackpool Electric Tramways Company, Limited.

ON Saturday, the 28th ult., the first annual meeting of this Company was held in the company's offices, Alderman Horsfall, Mayor of Halifax (chairman), presiding.

The Chairman moved that the report, of which a copy had been sent to each shareholder, be taken as read, and adopted by the meeting. The report showed that the whole of the 3,000 shares of the company had been allotted, and £14,242 paid up, or £5 per share ; 150 of the shares were allotted to Mr. M. H. Smith, engineer to the company. There was an available balance of net profit on the passenger traffic from the 12th September to October 31st of £63 10s. 6d. ; but there were various liabilities, amounting to an estimated amount of £2,000.

Mr. Bannister (Liverpool) seconded the adoption of the report.

Dr. Kingsbury asked for information upon several items, first upon the item of £140 for cars, balance of contract ; next upon travelling, hotel, and other expenses, joiners' work, electrical fittings, &c., £171. With reference to the estimated additional liabilities of £2,000, he could not consider the way of including these was a satisfactory one, as it seemed to say the directors had undertaken liabilities, of which they did not know the extent, but which might be £3,000, or even more, for all the information the shareholders had upon the subject. Then on the other side of the balance-sheet, it would only be fair if some information was given as to the large sums paid to the contractor on account (£1,800). Who was the contractor and what remained to be paid him ? Then as to the item of £4,000 odd for electrical fittings, on account. It was a large item, and there might be another £4,000 to pay for all the balance-sheet showed to the shareholders. There was an item of £500 to Mr. M. H. Smith, in consideration for the assignment of his patent right to Blackpool. That was perfectly right, but what about the £400 for engineer's commission to the same gentleman ; under what agreement was this to be paid ? Then as to the item of £213 for preliminary expenses, in the form of travelling and hotel bills, what was the relation of that item to the item of £171, 16s. 11d. mentioned in the liabilities on the other side of the balance-sheet ? These items were perplexing, and he would move an amendment to the adoption of the report, that it be referred back to the directors, who should be requested to state on the face of it what sums they were indebted for, how much they were spending, and how these amounts were to be met, also that the items he had pointed out should be differentiated. He had never seen a balance-sheet so successfully designed to leave the owner of it in ignorance of the real facts of the case.

Councillor Bickerstaffe suggested that Dr. Kingsbury should wait until answers had been given to his questions before moving an amendment.

Dr. Kingsbury said he would be glad to wait.

The Chairman was glad Dr. Kingsbury had dissected the balance sheet. At a first meeting it was a difficult thing to furnish a true and correct statement of all their liabilities—(hear, hear)—and he thought the N.B. in the balance-sheet showed this, when it stated that, in addition to their liabilities, there were £2,000 of estimated payments to be made. In answer to Dr. Kingsbury's questions, he had to say that since the balance-sheet had been prepared, the contractor's account—Mr. Cardwell's—had been settled for £348. Then as to the contract for motors, with Elwell, Parker, and Co. Some of the earlier motors supplied had not been satisfactory in their working. Some alteration had been made, and a second motor had just come in, which had been working exceedingly well for a fortnight, and there was a balance of £700 to be paid if the motors worked satisfactorily. Next as to Smith, Baker, and Co.'s contract for electrical fittings, &c., there was a balance due to them of £400, as near as could be made out. Then there was a balance of £210 due to Coop, the contractor, which was expected to be reduced. He was glad to say that the balance due to the engineer and for other items, of £400, would only be about £100. So that their liabilities, instead of being £2,000, would only be something like £1,700. The first six motors did not answer. They would not require ten motors, as they did not need one for every car ; Messrs. Elwell and Parker would take back the old motors at their own cost, every penny of it, as the Tramway Company had a very stringent contract which Messrs. Elwell and Parker had acted up to in a most gentlemanly and honourable manner. Mr. M. H. Smith received his commission upon the electrical work and the centre channel, and then received 2½ per cent. upon the engine and cars, but the £2,000 in the N.B. of the balance-sheet would cover any liabilities they had incurred.

Mr. Hyde asked the reason of the rails having to be filled in with spun yarn.

Mr. Broadbent said they had spent something like £160 in cleaning out the pitch from the channel. They had had to take up one side of the channel bodily, and had made a tumming of an inch all along the route. The Corporation said that must be made up by a certain time, and so it had been thought best to pack it with gaskin first, and then pitch it on the top, and he was sorry to say they had not gone through more than three-fourths of it, but in three or four days it would be covered on the top of the gaskin.

Mr. Hyde said it was the first time he had seen a railway held up by a bit of gaskin.

Dr. Kingsbury said he was partly satisfied, and partly not so, with the assurances he had received, but it would be much better if these balance-sheets stated positively, and not proximately, the amount of their liabilities.

Mr. Dean presumed that the £500 for the Corporation concession of patent right was part of the £2,000 agreed to be paid to Mr. Smith. Was that to be paid to him irrespective of the failure of the motor.

The Chairman said the failure of the motors was from a delicate bit of machinery, and they were under Mr. Smith's specification. Messrs. Elwell and Parker thought they had something better than Mr. Smith's idea, and tried it, but it had been a failure, so they were now carrying out the original arrangement, which was working most successfully, and at no extra cost to the company. There had been no failure of Mr. Smith's plans.

Mr. Ormerod asked if the £2,000 was to be paid to Mr. Smith without any condition as to the difficulties of his method of working. ("No, No.")

The Secretary read the clause in the agreement with Mr. Smith, which stated that the said 50 shares should not be allotted to him unless his invention was successful at the time named. That time had not yet arrived.

Dr. Kingsbury said under the original agreement between Mr. Horsfall and Mr. Smith the undertaking was to give to the latter for his invention £500 on the allotment of his shares—that had been paid ; £1,000 in 100 fully paid up shares on the first of January next, and a fresh sum of £500 on the first of January, 1886, the latter to be paid in shares or in cash at the option of Mr. Holroyd Smith ; the latter seemed a distinct payment for the success of his patent. To that surely the £400 previously referred to was for superintending his own work. ("No, No.")

The Chairman said the £400 was held out as a kind of premium irrespective of his electricity. If Mr. Smith had failed in his electricity they should have refused to carry out this agreement. Mr. Smith was so convinced of the possibility of carrying out his undertaking that he agreed to take his money in shares, so that if he failed he would lose his remuneration. But the directors were satisfied that it was not a failure. There was no truth that the directors were at variance with the Corporation, who were working harmoniously and were as anxious as the directors that this electric tramway should be a success. (Hear, hear.) The delays had arisen from difficulties both from the Corporation and from themselves.

In answer to Mr. Parr (Manchester) and other shareholders Mr. Holroyd Smith said he had been so absorbed in his work that the agreement was almost a bygone thing in his mind, and he had forgotten the fact that the £1,000 in shares were to be given to him in January. He assured them he should be a considerable loser by the time and expense he had been put to in the service of the company. A gentleman known to one of the directors had received a similar concession for a tramway, and asked for this concession more than he (Mr. Smith) would receive altogether. The company had a cheap bargain on their part.

Dr. Kingsbury's amendment was then withdrawn, and the report and balance-sheet were adopted unanimously.

The three retiring directors, Councillor Bickerstaffe, Mr. J. Broadbent, and the Chairman, were re-elected. Dr. Scholefield resigned, and Dr. Kingsbury was elected in his place.

Mr. J. T. Taylor, of Halifax, was re-appointed auditor to the company.

Mr. Hyde asked what were the terms agreed upon with the Corporation.

The Chairman read the statement printed upon the prospectus, which gave a lease of seven years to the company, with right of renewal at the end of the seven years. He then, at the request of Mr. Hyde, produced the original document, and read from it the clause with respect to the power of renewal, the pith of which was that if at the end of the seven years the Corporation do not purchase the plant and works of the company, the company are to have the right of renewal for the succeeding seven years, and at the end of that time the same conditions are to hold good for another seven years' renewal. A depreciation of 2½ per cent. per annum to be allowed if the Corporation became purchasers, of which they would have to give notice before the expiration of the first three months of the seventh year of the lease.

Dr. Kingsbury moved a vote of thanks to the chairman.

Mr. Bannister seconded, and it was carried unanimously.

Brazilian Submarine Telegraph Company, Limited.—The directors of this company have declared an interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, free of income tax, for the quarter ended 30th September last, and payable on the 24th inst. The books of this company will be closed from the 17th to the 23rd inst., both days inclusive.

Edison's Indian and Colonial Electric Company, Limited.—A petition has been presented to the Court for the confirmation of a resolution reducing the capital from £250,000 to £117,500.

Eastern Extension, Australasia and China Telegraph Company, Limited.—The directors have declared an interim dividend for the quarter ended September 30th, of 2s. 6d. per share, free of income-tax, payable on January 15th.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of November was 2,707, estimated to produce £2,250, against 2,743 messages, producing £2,326 in the corresponding month of last year. The receipts for the month of August, estimated at £2,200, realised £2,262.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 30th November, are £2,108, as compared with £2,344 in the corresponding period of 1884. The August receipts, estimated at £4,434, realised 4,548.

The Great Northern Telegraph Company, Limited. The receipts for November, 1885 were £22,800; from 1st January to 30th November, 1885, £264,440; for the corresponding months of 1884, £257,480; and of 1883, £236,480.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 4th were £2,576, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended December 4th were £3,376.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending November 30th were £3,775.

NEW PATENTS—1885.

14129. "Microphones for use in telephonic instruments." J. S. Sellon. Dated November 18.

14581. "Lightning conductors." R. P. Eidsforth, F. J. Mudford. Dated December 3. *(Complete.)*

14837. "Ships' telegraphs." O. White. Dated December 3.

14842. "Meters for measuring electric currents." G. E. Dorman. Dated December 3.

14845. "Incandescent lamps." W. Maxwell. Dated December 3.

14853. "Magnetic oil lamp. L. Mordant. Dated December 3.

14855. "Indicating electrically the quantity or direction of flow of fluids, &c." J. Sax. Dated December 3.

14891. "Transmitting electric ships' telegraph." W. Skinner, J. Farquharson, D. W. Lane. Dated December 4. (*Complete.*)

14917. "Telephony and telegraphy." S. Z. de Ferranti, G. L. Addenbrooke. Dated December 4.

14958. "Electric batteries." O. Marsh, F. E. Burke, W. Webster. Dated December 5.

14963. "Induction apparatus.' S. Schuckert. Dated December 5.

14986. "Electric storage battery." G. J. Atkins. Dated December 7.

15006. "Arc lamps." G. G. Andre. Dated December 7.

15040. "Voltaic battery." S. W. Maquay. Dated December 8.

15050. "Portable electric thief detector." A. Coke. Dated December 8.

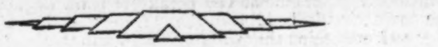
15060. "Electrical apparatus for marking or scoring the game of billiards and for other numerical indicating purposes." F. E. Burke. Dated December 8.

15067. "Electrical arc lamps." E. Edwards. (Communicated by O. Luck and P. Blasche.) Dated December 8.

15078. "Forming conduit sections for underground conductors, &c." W. P. Thompson. (Communicated by J. R. Burdick and D. H. Dorsett.) Dated December 8. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

15898. "Improvements in some forms of electro-magnet and solenoid cores." H. F. Joel. Dated December 3. 4d. Relates to the iron cores of electro-magnets and solenoid coils made in the form of cone or double cone, or spindle or such like shape. The inventor makes such iron cores of a tape, ribbon, or narrow strip of sheet iron, as shown by the fig., instead of solid iron usually employed.



16375. "Improvements in galvanic batteries." A. Schanschieff. Dated December 12. 6d. The inventor forms the positive and negative elements of the battery in the form of discs mounted upon an axis, to which a slow revolving motion can be imparted; the axis of the discs is mounted in bearings above the top of a trough, into which the lower part of the discs dip, so that one half of each disc will be exposed to the atmosphere and the other half will dip into the liquid in the trough—in the trough are partitions forming a series of cells.

16554. "An improved apparatus and process for the electrolytical separation and deposition of metals." A. M. Clark. (Communicated from abroad by B. Moebius, of Mexico.) Dated December 16. 10d. In refining silver with this apparatus, the silver to be refined is cast in blocks or bars, provided in the upper edge with threaded apertures for receiving the ends of screws, which pass freely through a bar or rod, having its ends bent up so as to adapt them to rest upon the conductors, the bent ends of the bars or rods being recessed in the bottom to receive the conductors, and prevent shifting of the bars on the said conductors. The screws are provided, at their upper ends, with handles, and above the bar winged nuts are screwed on the screws, whereby, by turning the said nuts, the anodes can be raised or lowered in relation to the bar or rod resting on the conductors. The lower parts of the screws are plated with gold or platinum, and, when screwed into the upper edge of the anode, they may be provided with a coating of varnish to prevent their being acted upon by the solution.

16602. "Improvements in indicating apparatus to be used in connection with electric bells, and for other purposes." G. H. Jennings, S. Jennings and E. G. Brewer. Dated December 17. 6d. Consists of a number of electro-magnets, each corresponding to a push bottom, arranged in a circle, and of a magnetised hand which rotates when one of the magnets is excited until it comes opposite the latter.

16632. "New and improved electric alarm watch or clock stand, and certain improvements in or connected with watches or clocks for actuating the said alarm or an ordinary electric bell." I. Burmann. Dated December 18. 6d. Consists of a stand provided with an electric alarm arrangement for watches or clocks, which latter are provided with an arrangement so as to cause the alarm to sound at any desired time, or the watch or clock may be put in connection with the push of an ordinary electric bell, so as to actuate it at a distance.

16656. "Improvements in automatic electrical switches." W. B. Sayers and G. Hookham. Dated December 19. 8d. On a horizontal stand or table the inventors fix a vertical bar electro-magnet, having a core about five inches in length and three quarters of an inch thick. The lower end has rectangular polar extensions to right and left. The central portion is wound with wire of comparatively high resistance, say No. 22 B. W.G. and over this one or two layers of wire of much lower resistance, say No. 10 B. W. G. These two coils are so connected with the generator and the battery that if the current is from the generator to the battery, the inner coil is short-circuited, and the current passes through the outer coil with but slight fall of potential, but if the current is reversed, the circuit through the outer coil is broken, and the current passes through the inner coil of high resistance. If, in the former case, the lower pole is positive, in the latter it is negative. The upper pole is continued a short distance vertically, and to it is hinged by means of a pin passing through it from front to back a bent or horseshoe electro-magnet. The pin passes through the central point of the bent magnet at right angles to the plane passing through the axis of its limbs; and consequently the axis of the vertical bar magnet will lie in the same plane; in which also the bent magnet is free to swing to a limited extent to right or left. The two limbs of this magnet are wound with a large number of turns of very fine wire, say, No. 30 B. W. G., and have a very high resistance. The winding is similar in every respect on the two limbs; and when no current is passing through any part of the system the swinging magnet will balance about the pin on which it is hinged. This magnet is so wound that its poles have opposite names, the central point being neutral; and as the current always passes through its coils in the same direction, each pole always remains the same The coils of the swinging magnet are connected to the battery or generator as a shunt or derived circuit. The inner coil of the vertical magnet or "feeler" coil completes the circuit between the generator and battery and is so connected that when the E.M.F. of the generator exceeds the E.M.F. of the battery the current through it will produce a polarity in the vertical bar magnet such that the swinging magnet will take up the position in which contact is made between the generator and battery terminals through the main-circuit coil; the "feeler" is then short-circuited, and the current through the main-circuit coil suffices to maintain the swinging magnet in position. If, however, the E.M.F. of the generator should fall below that of the battery, the current through the main coil will be reversed, and the reversed polarity of the vertical magnet will cause the swinging magnet to move over to the other side and so break the main circuit. As soon as the main circuit is broken, the "feeler" coil again comes into play and maintains the swinging magnet in this position until the E.M.F. of the generator is restored, when it causes the main circuit to be re-established in the manner just explained.

16655. "Improvements in connections or couplings for electric leads and for incandescent and other lamps." W. B. Sayers and G. Hookham. Dated December 19. 6d. Provides means whereby a flexible lead can be readily attached to and detached from the source of supply.

16954. "Improvements in electro-telephonic apparatus." A. A. Campbell-Swinton. Dated December 27. 6d. Consists in arranging one part of the current regulators or variable contacts themselves as pendulous hinged or suspended contact or contacts, the other part consisting of a fixed contact or contacts, the parts being so combined that the former bear upon the latter, and the air waves due to the voice or other sound act directly upon the pendulous hinged or suspended contact or contacts, no diaphragm or tympanum being used, the said contacts being simply enclosed in a case provided with an opening for the voice or sound. The said pendulous hinged or suspended contact or contacts may be hinged, suspended, or mounted in any suitable way, and so, if desired, that its or their degree of bearing on the other contact or contacts may be varied.

16964. "Improvements in telephonic switching apparatus." A. R. Bennett. Dated December 27. 6d. The object of the improved telephonic switching apparatus is to increase the speed with which the wires converging in a telephonic exchange or switch-room may be joined together and separated according to the requirements of the subscribers.

1885.

2122. "Improvements in the construction of dynamo-electric machines." H. Jones. Dated February 16. 6d. Relates to that type of dynamo-electric machine known as the Siemens H armature machine, and consists in forming the armature of a series of soft iron discs, of T form, the upper edge of the transverse member of each forming an arc of a circle; each disc being arranged longitudinally upon a central spindle. Said discs are placed so that each alternate one is opposite to the one preceding it, so that there is a space left between each individual disc of the series, equal to its thickness.

2812. "Apparatus for electrical illumination of railway trains." R. H. Woodley. Dated March 3. 6d. Relates to the arrangement of a dynamo-electric machine, and an accumulator or several accumulators with electrical conductors and incandescent lamps on a railway train, in such a manner that the dynamo machine may be used to charge the accumulator or accumulators, with or without working the lamps, and that the accumulator or accumulators may alone work the lamps, the dynamo machine being automatically cut out of circuit when the potential of the dynamo current is reduced below that of the accumulator.

5587. "Improvements in instruments for measuring electricity." L. B. Miller. Dated May 6. 6d. Relates to instruments known as ammeters and voltmeters. The inventor takes a short length of thin soft iron wire, and attaches to one end a pointer of aluminium or other metal. The iron is pivotted in the middle and moves over a scale fixed on the surface of a vertical piece of wood forming part of the framework of the instrument. Round the piece of soft iron wire, but not close to it, is wound a coil of wire for conveying the current to be measured. The plane of the convolutions of this wire forms an angle of about 45° with the vertical needle, but this angle can be varied by suitably pivotting the metal reel on which the wire is wound.

6487. "Improvements in telephones." K. S. Dembinski. Dated March 14. 4d. Relates to a particular form of a magneto telephone.

6488. "Improvements in induction coils." K. S. Dembinski. Dated March 14. 4d. Relates to details, especially as regards the dimensions of the wire, in the construction of the ordinary telephone induction coils.

7548. "Improvements in synchronisers for clocks." C. H. Pond. Dated June 20. 6d. The object of the present invention is to provide the clock with a synchronising mechanism which is electrically controlled through a regulator clock placed in circuit with one or more clocks to be synchronised. The regulator, when it marks the hour, closes a synchronising circuit, which, simultaneously, by vitalising an electro-magnet at the clock to be synchronized, closes the winding motor circuit, sets this motor in operation, and also simultaneously places certain parts of the synchronising mechanism in the proper position to be acted upon by the rotation of the parts in winding. This effects the synchronising, and, when this is effected, closes a shunt circuit that cuts the electro-magnet out from the synchronising circuit.

8528. "Improvements in dynamo-electric machines." W. R. Lake. (Communicated from abroad by E. R. Whitney, of America.) Dated July 14. 6d. Consists essentially in the novel construction of the poles and cores of the field magnets, which, instead of being made of single castings as heretofore generally practised, or of a series of plates or wires or rods fastened together in close proximity to one another so as to produce practically a continuous solid mass of metal, are made of a series of plates or sections fastened together by bolts or other devices, with an open air space between each pair of the said plates, which are also insulated from one another around the bolts or fastenings. The series of plates when thus fastened together is of the general shape, externally, of the usual field magnets, and the coils may be wound upon them in the usual manner.

8566. "Improvements in or relating to dynamo-electric machines for preventing sparking in such machines." T. J. Haniford. (Communicated from abroad by R. H. Mather, of America.) Dated July 15. 6d. Consists of a magnet, or a number of magnets, as the case may be, in addition to, or in extension of the field magnet, of the machine. This magnet has for its sole purpose the production of a discharge current in those coils of the armature which are, for the time being, short-circuited by the brush, or brushes, of the commutator.

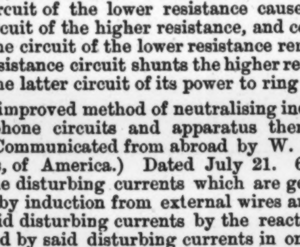
8568. "Improvements in or relating to dynamo-electric machines for supporting the armatures of such machines." T. J. Handford. (Communicated from abroad by R. H. Mather, of America.) Dated July 15. 4d. The objects are accomplished by means of a cradle, or frame, consisting of two metallic rods which are firmly secured to the field magnet, and are rigidly connected with each other by means of yokes which furnish the bearings for the armature shaft.

8621. "Improvements in and relating to electrical signalling or alarm apparatus for railway and other purposes." W. R. Lake. (Communicated from abroad by M. W. Parrish and M. F. Parrish, both of America.) Dated July 16. 6d. Consists in two electric circuits, one of which is of a higher resistance than the other, an electrical generator, or battery, in said circuits, and a signal bell, or other suitable alarm, or signal in the circuit of the higher resistance, and circuit breakers, one or more, in the circuit of the lower resistance, the whole so constructed and arranged that a break in the circuit of the lower resistance causes the bell to be rang by the circuit of the higher resistance, and consequently not to ring when the circuit of the lower resistance remains unbroken, as the lower resistance circuit shunts the higher resistance circuit, thus robbing the latter circuit of its power to ring the bell.

8777. "An improved method of neutralising inductive disturbances in telephone circuits and apparatus therefor." W. P. Thompson. (Communicated from abroad by W. A. Jackson and J. C. Chambers, of America.) Dated July 21. 6d. Consists in neutralising the disturbing currents which are generated in telephone circuits by induction from external wires and other objects by opposing said disturbing currents by the reaction of electrical charges induced by said disturbing currents in one or more insulated bodies which are capable of being electrically charged by induction, and are also good conductors.

8788. "Improvements in electric cable recorders." M. G. Farmer. Dated July 21. 6d. The instrument consists mainly of two parts, one of which is an electro-magnetic device or its equivalent, that is moved to a certain extent by impulses of current, and the other the device which records such movements. As a means of recording the movements of this device, however, the inventor employs a short length of fine platinum wire connected with two wires of good conducting qualities that project from the moving instrument, and a travelling band or strip of red tissue paper which is carried past the platinum wire, the heat of which leaves upon the paper a whitish line.

8860. "An insulator for electrical apparatus." B. Pell. Dated July 22. 4d. Relates to an insulator which can readily be interposed between any electrical apparatus and the earth, and which is so constructed that it retains its insulating properties for a considerable period. A is an inverted cup of ebonite, vulcanite, or other suitable non-conducting material, with a rod, B, in its centre projecting beyond the rim of the cup, and terminating with a thread upon which is screwed a disc, C, of the same material, having an annular groove such that when the disc is screwed tightly home, it presses against the rim of the cup, A; D is a screw for fixing the insulator, if desired, to the testing instrument; E is solid paraffin wax, which is poured into the cup whilst hot and allowed to cool and set therein. When a test is about to be taken, the disc, C, is a little unscrewed so as to break the contact between it and the rim of the cup, A. When the insulator is not in use, the disc, C, is screwed tightly against the cup, A, so as to prevent dust or moisture from entering the cup.



8995. "An electro-magnetic type-setting engine." W. DREYER. Dated July 25. 6d. Relates to an electro-magnetic type-setting machine, whereby printer's type is automatically conducted into a suitable receiving channel and set up in line, said machine differing from machines hitherto employed for this purpose principally in the following points, viz:—1. The whole type setting effort or manipulation is reduced to the striking of keys corresponding with the type which is required to be set, and thus the work may be done by any person without previous apprenticeship, whilst an experienced operator will be able to do four times more work than by hand only. 2. All moving mechanism, either rectilinear or rotatory, is avoided. 3. The only force employed, apart from the gravitation of the types, is electro-magnetism, and it is by this force that the types are discharged from the upper cells, and are pushed into the grooves where the lines are formed. 4. The discharged types enter a funnel of special construction, and by their weight glide on into the receiving cell, whence they are thrust into the grooves of the support.

CORRESPONDENCE.

The Law of Magnetic Attraction.

By perusing some back numbers of your interesting REVIEW, I found in your edition of the 25th of April, 1885, an article headed "Magnetic Induction," in which Mr. W. Cooper describes some experiments concerning supposed discrepancies in the law of magnetic attraction. The reason of these discrepancies is explained by Dr. P. H. Van der Weyde in your edition of the 23rd of May this year. Kindly allow me space in your journal for a few remarks upon this subject.

Though I perfectly agree with Dr. P. H. Van der Weyde as to his explanations, I have in vain tried to understand how Mr. Cooper has obtained the fundamental law, that a magnet attracts its armature with a force inversely to the square of the distance, *i.e.*, that a magnet attracts iron in accordance with the named law, which, as far as I know, only applies to the law for attraction or repulsion between two poles of permanent magnets, and which is represented by the formula $f = \frac{m\,p}{d^2}$, m, p and d being respectively the intensities of the two poles and their distance. In case the one pole only, for instance, m, being permanent, and the other, p, produced in soft iron by induction of m, this formula cannot be used, because p is not constant in respect to d, but follows the law $p = c\,\frac{m}{d^2}$, where c is a constant and $\frac{m}{d^2}$ equal to the intensity of the magnetic field produced by m. By now inserting this value of p in the named formula we arrive at the fundamental equation, namely, $f = c\,\frac{m^2}{d^4}$ for the attraction between the pole of a magnet and soft iron.

I may add that I have in vain looked for the formula of this *fundamental* law in different text books, and I should therefore feel obliged for your opinion on the subject.

K. G.

Copenhagen, 3*rd December*, 1885.

[We are not aware that the law arrived at by our correspondent has been stated in any text book.—EDS. ELEC. REV.].

Re Electrical Formulæ.

Mr. Andersen's reply to my last letter calls, I think, for a few further remarks from me.

In the first place, I would point out that my remarks referred entirely to magneto-electric machines; Mr. Andersen's article on dynamos not having been published until after I had written my letter. Yet Mr. Andersen in his letter, refers entirely to dynamo machinery and not to magneto machinery.

The question at issue, as yet, between Mr. Andersen and myself is simply this:—Given two magneto machines, performing work at the same rate, having equal amounts of conductor in their armatures, and the same linear velocity: Mr. Andersen asserts that the electrical efficiency will be proportional to their "F," while I maintain that their electrical efficiency will be proportional to their "F^2."

On page 430 Mr. Andersen says:—

"Now the activity as well as the electrical efficiency of a dynamo depend, as I shall show hereafter, on F in so simple a manner that it is easy from the value of this quantity to derive the true electrical merit of different dynamos."

Now when we treat of the effect produced in a system by varying one of the component parts of that system, it is customary to treat of the effect produced whilst that part alone of the system varies; the remaining parts of the system being constant. Let this be done in the case cited by Mr. Andersen, and it will be found that the rate at which the machines perform work will be proportional to their F^2, while, of course, the percentage of waste is constant; or, if the machines perform work at the same rate, the percentage of internal waste will be proportional to their F^2 inversely.

The purport of my last letter was to show Mr. Andersen that his method of treating of the effect produced by the simultaneous variation of two component parts of a system was neither customary nor advisable.

Mr. Andersen's remark that his formulæ were worked out for use in constructing dynamos, is irrelevant.

In his further explanation of the use to which he would apply the quantity F, Mr. Andersen has changed the subject from "*electrical*" to "*commercial*" efficiency. In Mr. Andersen's previous communications the words "electrical efficiency" and "*electrical merit*," frequently occur; but nowhere can I find the word "*commercial*." Changing, however, the subject from electrical efficiency to commercial efficiency, Mr. Andersen's fresh conclusion, that the commercial efficiency varies directly as F, is not quite correct.

The equation (page 486) for the annual expense of converting a given amount of energy, is obvious enough; but Mr. Andersen's explanation of it in the following column is by no means clear. If he means, that with a given plant of machinery expending a constant amount of internal work, the electrical output of work will vary directly as F, this is not exactly the case; the available work produced would not vary as F, but as $\left\{ F + (F - 1)\,\frac{\text{internal work}}{\text{external work}} \right\}$. In a similar manner, the commercial efficiency of the plant, according to the general acceptance of the term would vary as:

$$\left\{ F + (F - 1)\,\frac{\text{total current expenses}}{\text{value of external work}} \right\}.$$

While hoping that the preceding remarks will convince Mr. Andersen that the coefficient "F" has neither the importance nor the use that he has claimed for it, I should like, in conclusion, to say a few words of this coefficient itself and of the term "figure of merit" that he has associated with it.

This coefficient F has had the name of "*effective* strength of magnetic field" given it, by Prof. Ayrton I think (but am not sure). This name recommends itself, as it is explanatory of the properties to which it refers.

I cannot understand why Mr. Andersen wishes to introduce the term "figure of merit." If it were adopted it would have exactly the same meaning as the word efficiency, which is now in use, and it is not, moreover, nearly as explanatory. And further, the duties required of dynamos differ so much in their nature, and the circumstances accompanying the performance of those duties are so various, that it is scarcely possible, and it is certainly not probable, that electricians will ever agree upon one general criterion by which the intrinsic values of machines of different types may be determined.

W. Moon.

"Primary" and "Secondary" Batteries.

There is one statement in the article by M. Hospitalier with which I cannot agree. After quoting the definition I have offered of a secondary battery, he says: "It results from this that the distinction between a primary and secondary battery rests solely in the mode of employment, and that the elements which we have just mentioned would be, according to circumstances, primary or secondary."

I cannot find, in what I have said, the premises for this conclusion. On the contrary, it seems to me that I have guarded against the inference by the use of the word "may be" instead of "are" in the definition referred to, and by the statement that—"merely removing the elements of a battery from one receptacle to another, prior to charging or discharging, does not invalidate its claim to be considered a secondary battery, provided the charge and discharge *can be* effected without such removal, and without the substitution of a different electrolyte."

In one, at least, of the batteries I have devised, the positive (spongy lead) element cannot safely be employed more than once without some manipulation. This is very far from being the case with the last form of battery I have constructed. The former, according to my definition, would be a "primary," and the latter, whether the elements be removed or allowed to remain *in situ* for recharging, would be a "secondary" battery.

Desmond G. FitzGerald.

Secondary Generators or Transformers.

Messrs. Zipernowski, Deri and Blathy, in their letter published in your issue of the 28th ultimo, seek to evade the question we had raised by stating that our apparatus are constructed, as regards the diameter of the iron core and the bobbin, upon the principle indicated in Maxwell's treatise, and they affect to believe that our claims are based upon this structural peculiarity. We cannot allow such an assertion to pass without a further protest.

The chief characteristic of our invention, recognised in the report presented by the International Jury of the electrical section of the Turin Exhibition as being the principal reason for the high return in the transformation of energy, consists in the employment of the same mass of metal in the construction of the inducing and the induced circuits, and in their symmetrical position as regards the common magnetic field, which arrangement was never indicated prior to our experiments, either by Mr. Maxwell or anyone else; and, although Messrs. Zipernowski, Deri, and Blathy may contest the value of an opinion given upon the originality of an invention by such *savants* as composed this International Jury, we very much doubt whether experts, who might be called upon in a court of law, would maintain a contrary opinion to the one expressed by the jury. There is another point which should be definitely disposed of, and it is this: Messrs. Zipernowski, Deri, and Blathy deny that Mr. Fuller's apparatus are constructed with a closed magnetic field, and they persist in declaring themselves to be the inventors of this arrangement. Without entering into the question of their rights, it will suffice to remove all doubt upon the point if we refer to the following extract from the specification of Dr. John and Dr. Edward Hopkinson, No. 14,233, of the 24th October, 1884, which was lodged after a visit which Dr. Edward Hopkinson honoured us by making at the Turin Exhibition:—

"We prefer to make this coil in such a manner that the core forms a complete magnetic circuit. This may be best attained by making a ring of iron wire or of plates of sheet iron, and winding it with wire as a Gramme ring is wound, but differently connected, so that the magnetic circuit may be complete within the ring. The shape of this ring may be varied, provided its magnetic continuity be maintained. Such a self-induction coil is described in specification of a patent granted to one of us, No. 3,362, 1881. But such a ring induction coil may be wound with two coils of wire, forming two distinct circuits, and the current from the machine be passed through one coil. The induced current in the other coil may then be employed to produce a useful effect."

All that remains, therefore, to Mr. Zipernowski is his hyper-compound machine, and we know very well that he went to a good school (Messrs. Siemens and Halske) to learn how to construct alternate current machines; but, without expressing any doubts as to the proper working of any machines made by him, we have very good reasons for preferring the last type of dynamo adopted by Messrs. Siemens.

Messrs. Zipernowski, Deri, and Blathy now state that the information obtained from Mr. Gaulard only convinced them that our apparatus were bad, and that what they learnt from us at the Turin Exhibition "was the method how a transformer was not to be constructed." This certainly was not the opinion expressed by Mr. Blathy, who upon leaving Turin in June begged Mr. Gaulard not to treat for Austro-Hungary until he should have convinced his company of the value of our invention. In the event of Mr. Blathy requiring to refresh his memory on this subject, he need only refer to the electricians present at all our interviews, who will remind him that the closed magnetic field was mentioned as being employed by us in cases where the E.M.F. developed by the apparatus would be maintained constant.

We have a letter from Mr. Blathy, written in August, 1884, of an interesting nature, which will be produced at the proper moment.

Lucien Gaulard.
J. Dixon Gibbs.

London, *December 7th*, 1885.

Recorders.

I saw in one of your numbers a few weeks back, a notice referring to my vibrator as used with the small recorder, and I have been asked two or three times by different people if it will also act with the large recorder. I have tried it to-day with the large recorder, and have succeeded perfectly in getting a good clear line and signals; there is no apparent difference whatever in the clearness of the signals. The change is very simple indeed, and used as an auxiliary with the ordinary method, should save a lot of trouble and delay, particularly in climates where the electrification of the ink is difficult to maintain. Anyone wishing for information as to how to apply it, can obtain it by dropping me a line.

F. Pescod,
Station Manager, Panama.

Compañia Telegràfica de Centro y Sur América.
November 15th, 1885.

Electrical Regulators.

I should like to know who are the makers of Willans and Richardson's regulating apparatus, as described in the *Lumière Electrique*, of 21st November last, and as they are English names, I take the liberty to ask if you know where these apparatus are made.

M. Herrmann.

Calçada do Lavra, 6, Lisbon.
December 3rd, 1885.

[Doubtless the manufacturers will answer our correspondent direct.—EDS. ELEC. REV.]

Electro-Plating.

Could any of your readers tell me the way to mark lines or letters on polished steel, such as are marked on Chesterman's steel rules? Is it obtained in an electroplating bath or in what other way?

A. F.

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